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ABSTRACT

The purpose of this study of food consumption in the National School Lunch Program (NSLP) was to: (1) conduct a comprehensive review of literature on plate waste in school foodservice and other institutional foodservice facilities, (2) report the results of a pilot study designed to determine the degree of plate waste in the NSLP and its relationship to the nutritional benefits of the program, (3) define factors influencing food consumption as reported in the literature, (4) review actions taken by the United States Department of Agriculture (USDA) to minimize plate waste, and (5) provide suggestions and recommendations for improving food consumption. Data were collected on two consecutive days from a nationwide sample of elementary and secondary schools in 35 states and the District of Columbia. Among the results it was found that student participation in the school lunch program was significantly greater at the elementary grade level than at the secondary grade level. Schools which served lunches prepared on site had a significantly higher rate of participation than did schools with preportioned-delivered lunches. In elementary schools, lunches prepared on site contained significantly higher levels of iron and food energy than lunches preportioned and delivered. Amounts and kinds of foods wasted and nutrients most often lacking were identified. (Author/RH)

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FOOD CONSUMPTION AND NUTRITION EVALUATION
THE NATIONAL SCHOOL LUNCH PROGRAM

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prepared by

FOOD AND NUTRITION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

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Executive Summary

I. Introduction and Background

The National School Lunch Program (NSLP) as defined in the National School Lunch Act of 1946, serves to safeguard the health and well-being of the Nation's children and to encourage the consumption of agricultural commodities. As designed by Congress, it is a means of providing nutritious, reasonably priced lunches to school children and contributing to a better understanding of good nutrition and improved food habits and their relationship to health. The program has supported these objectives since its inception. However, recent attention has focused on food habits of today's students and the attitudes of students and the community toward school foodservice. These food habits have caused concern about the consumption of foods in the NSLP and have prompted the U.S. Department of Agriculture (USDA) to review the effectiveness of the program in meeting the objective of providing nutritious lunches which are acceptable to school children.

The nutritional requirements for lunches served in the NSLP are expressed in a meal pattern known as the Type A Pattern. The Type A Pattern, which includes foods from the four food groups found in the Daily Food Guide (2), was designed as a guide for providing approximately one-third of the Recommended Dietary Allowances (RDA) established by the Food and Nutrition Board, National Research Council, National Academy of Sciences, for food energy and ten indicator nutrients - protein, fat, iron, calcium, phosphorus, vitamin C, vitamin A, riboflavin, thiamin, and niacin. Current regulations for the NSLP specify that a Type A lunch shall contain a minimum of the following food components in the amounts indicated:

- 2 ounces of cooked lean meat or meat alternate
- 3/4 cup serving consisting of two or more vegetables or fruits or both
- 1 serving of whole-grain or enriched bread or alternate
- 1/2 pint of fluid milk as a beverage

This lunch pattern neither dictates nor indicates the degree of food consumption; however, it does represent an approximate nutrient level which should be available to students participating in the NSLP.

II. Purpose of Report and Procedures

USDA, as well as State agencies who share the responsibility of the administration of the NSLP, has recognized the need to hold food waste in the program to a minimum. While food waste has appeared to be a problem, definitive data have been limited. To obtain more information on the scope of the problem, the Department pledged to investigate the subject of plate waste in schools.

The purpose of this study, Food Consumption and Nutrition Evaluation, The National School Lunch Program, was to: (1) conduct a comprehensive review of literature on plate waste in school foodservice and other institutional-type foodservice facilities, (2) review factors influencing food consumption, (3) report the results of a pilot study designed to determine the degree of plate waste in 104 schools participating in the NSLP and its relationship to the nutritional benefits of the program, (4) review actions taken by the Department to minimize plate waste, (5) report current actions taken by the Department, and (6) provide suggestions and recommendations for improving food consumption in schools.

The Department reviewed food consumption data and nutritional analyses of lunches served as reported in studies conducted and/or funded by USDA as well as studies conducted by other federal agencies or institutions. The Department also contracted for a review of the literature on food waste in school lunch programs and similar group feeding situations relative to degree of severity, influencing factors, and impact of nutrition education.

III. A. Findings of the Review of Literature

1. Nutrients in lunches as served:

In accordance with the nutritional goal of the NSLP, a standard of one-third of the RDA for all indicator nutrients and food energy and a maximum constraint of 35 or 40 percent of calories from fat was used for comparing the results of the studies reviewed in this report. From various available studies which were reviewed, most Type A lunches as actually served to students in schools met or exceeded this standard for protein, calcium, phosphorus, vitamin A, vitamin C, riboflavin, and niacin (5, 6, 7, 8, 11). Head (20) reported similar results with the exception that some lunches were low in vitamin C. In a study conducted in Dade County Public Schools (12), lunches were slightly lower than the standard for protein and calcium (10 percent or less). In Guthrie's study (31), some lunches served with flavored or unflavored milk were low in calcium for the 11- to 14-year old group but adequate in calcium for the 7- to 10-year old group.

In almost all of these studies, iron and thiamin were the nutrients most often below the standard in lunches as served. Food energy was also consistently below the standard. However, even though the goal of the lunch is one-third of the RDA, it is recognized that foods eaten by children at other meals and snacks frequently provide more than two-thirds of the children's daily needs for food energy.

The standard used in these studies for fat was based on the percentage of calories provided by fat and varied in the different studies from a maximum of 35 percent to 40 percent. Results showed that on the average a standard of 35 percent of calories provided by fat was never achieved. In fact, staying below 40 percent seemed to be a problem. Lunches planned according to a nutrient standard, either manually or through the assistance of a computer, rarely achieved the constraint of 35 percent of the calories by fat.

2. Nutrients in lunches as consumed:

Even though most lunches achieved the standard for many nutrients as served, some fell below the desired level of nutrients as consumed because foods were not entirely eaten. Relative to the standard, consumption data showed that on the average vitamin C, riboflavin, and niacin were adequate in most lunches. However, in some studies there was a decrease in vitamin A (12, 32), phosphorus (12), calcium (8, 10, 12, 30, 32), and protein (8, 11, 12), putting these nutrients below the standard in most cases. Nutrients in lunches as consumed decreased to a level as low as 61 percent of the standard for vitamin A, 88 percent for phosphorus, 80 percent for calcium, and 77 percent for protein.

Iron, thiamin, and food energy, which are often low in lunches as served, were even lower in the lunches as consumed. Relative to the standard, the iron was as low as 30 percent (32), thiamin, 58 percent (12), and food energy, 54 percent (12).

3. Food consumption and its inverse, plate waste:

The nutritional contribution of the lunches served to and consumed by children in schools is directly related to the acceptance and consumption of the foods containing these nutrients. Many studies reported consumption data for various food categories. These included milk, meat or meat alternates (entrees), vegetables (raw and cooked), starches (rice, pasta, etc.), fruits, juices, and desserts. In selected studies, individual foods within these food categories were reported.

Milk had the highest acceptability and consumption rate of any food category. Results of all of the studies reviewed support this conclusion. Walling (18) reported a 5.8 percent waste of milk (94.2 percent consumption). Jansen and Harper (9) reported a consumption rate for milk of 88 percent in the fifth grade and 94 percent in the tenth grade. Their data showed that student acceptability ratings correlated well with consumption figures. Robinson (28) reported overall milk consumption of 88.5 percent. In this study the availability of flavored milk was a factor influencing consumption. Students in schools with flavored milk consumed about 16 percent more milk at school and 7 percent more milk on a 24-hour basis than students in schools which did not make flavored milk available. Guthrie (31) also found that milk consumption was affected by the option of flavored milk; however, even though results showed significantly less milk waste, there was a greater waste of food with this option. USDA (27) reported that both unflavored and flavored milk were well accepted in the Cincinnati Special Food Service Program for Children.

The meat/meat alternate category had the next highest level of acceptability and consumption. Jansen and Harper (9) combined consumption data from Type A lunches with data from lunches planned according to a nutrient standard and reported that the consumption of entrees ranged between 67 and 83 percent for the fifth grade students and between 68 and 91 percent for tenth grade students.

Doucette (19) reported that 93 percent of boys studied ate all of their meat compared to only 53 percent of the girls. Walling's study (18) also showed a low percent of plate waste for meat (12.7 percent waste or 87.3 percent consumption). The study of Dade County Public Schools (12) reported that meat or meat alternates were well consumed. Data showed that 75.8 to 95.6 percent of the students ate 80 to 100 percent of these foods.

All studies reporting consumption data found that raw and cooked vegetables were the least accepted and least consumed foods. The Dade County Public Schools study (12) reported that vegetables (raw and cooked) generally had low acceptability ratings and low consumption. This is evidenced by the fact that 37 to 96 percent of the students ate less than 50 percent of their vegetables. Walling (18) reported 52.5 percent waste of vegetables (47.5 percent consumption) and Doucette (19) found that between 22 and 45 percent of children ate no vegetables. The study of Cincinnati's Special Food Service Program for Children (27) also found that vegetables and salads were the foods most often refused. Jansen and Harper (9) reported that the consumption of vegetables averaged about 50 percent.

For other food categories -- fruits, juices, desserts, bread, and starches (rice, potatoes, pasta, etc.) -- percent consumption varied greatly (9, 11, 12, 13, 19). Overall plate waste was shown by Walling (18) to be 25 percent (75 percent consumption); by Consolazio (17) to be between 14 and 15 percent; and by Martin (16) to be between 16 and 20 percent in elementary schools and between 10 and 11 percent in the secondary school studied.

Food consumption was found by Harper and Jansen (13) to be affected by delivery system. Foods prepared and served on site had greater acceptability than did foods prepared in a central facility, preportioned and chilled or frozen prior to transport to the receiving school.

III. B. Factors Influencing Food Consumption

A review of the literature and experiences acquired in administering the NSLP reveal that there are many factors which influence the quantity of foods consumed by students and student participation in the program. These factors may be summarized as follows:

- acceptability of the menus planned, children's familiarity with the food, portion sizes, and the opportunity for choice of foods.

- training of school foodservice personnel in food preparation techniques (food quality) and methods of merchandizing and serving of foods.

- type of foodservice system, such as on-site food preparation and service or the use of preportioned meals delivered to schools.

- lunchroom environment, atmosphere in which food is served, the scheduling of the lunch, time spent waiting in line, time allowed for eating, seating arrangements, supervision, and the decor of the eating area.

- involvement of foodservice personnel, students, administrators, and parents and their commitment to an improved foodservice system.

- availability of nutrition education and encouragement of students to eat nutritious foods.

- personal and social aspects affecting food consumption, encounters with socially divisive situations and peer group pressures.

III. C. Food and Nutrient Consumption in the National School Lunch Program, 1977 - A Study conducted by the U.S. Department of Agriculture

To further define the magnitude of the food waste problem and its associated nutritional implications, the Department conducted a pilot study of food and nutrient consumption in schools participating in the NSLP. The purpose was to determine how well the Type A lunch was meeting the nutrient goal of approximately one-third of the RDA.

1. Objectives:

The principal objectives of the study were to: (1) assess the nutrient contribution of lunches as served to and consumed by students participating in the NSLP, (2) compare the nutrient contribution of lunches prepared and served in schools with on-site kitchens with lunches prepared in a central facility, preportioned and delivered to another school for service to children, (3) assess the acceptability of foods by school children by determining the level of consumption of different types of foods served in each of the two types of foodservice systems, and (4) determine the amount of food waste in schools in relation to kinds and amounts of foods served in the program. Other objectives of this study were to: (1) compare the nutrients in lunches served to and consumed by elementary students with secondary students (2) compare the level of nutrients consumed by males with the level consumed by females, and (3) determine how the Type A Pattern was interpreted by school foodservice managers when planning menus.

The study was also designed to obtain information on daily participation, prices charged to the students for lunches served in the two foodservice systems, the amount of foodservice training taken by menu planners, and the service of competitive foods.

2. Methodology:

Data for the study were collected from a nationwide sample of elementary and secondary schools in 35 states and the District of Columbia. The sample was composed of 52 schools which served lunches prepared on site and 52 schools which served lunches which had been prepared in a central facility, preportioned and delivered to the school for service to the children. The sample contained 80 elementary schools, 17 junior high schools and 7 senior high schools. Fifth, ninth, and tenth grades were used to represent elementary schools, junior high schools and senior high schools, respectively. Because of the small sample size, data from the ninth and tenth grade students were combined to represent secondary students for data analysis.

Data were collected for two consecutive days in each test school from September 1975 through February 1976. Data included demographic characteristics of schools, sample serving sizes of all foods, recipes for all menu items served, and plate waste from a representative number of students. These data were used to calculate the nutritional contribution of the lunches as served and consumed using Agriculture Handbook No. 8, Composition of Foods, Raw, Processed, Prepared, (49) as a primary source of nutrient data. The lunches were evaluated both in terms of nutrients per meal and the percentage of the nutrient standard (one-third of the RDA) which was achieved. In addition, the nutritional quality of lunches that completely met portion size requirements of the Type A Pattern was compared with the quality of lunches that failed to meet portion size requirements.

3. Results:

a. Demographic

Results of the study showed that the rate of student participation in the school lunch program was significantly greater at the elementary grade level (65 percent) than at the secondary grade level (50 percent) and that schools which served lunches prepared on site had a significantly higher rate of participation (65 percent) than did schools with preportioned-delivered lunches (54 percent). Overall student participation was 60 percent. In the elementary schools, participation in various lunch price categories (free, reduced price, full price) differed according to the foodservice system. Schools serving preportioned-delivered lunches had the highest participation in the free lunch category while in schools with lunches prepared on site, participation was highest in the full price category. In secondary schools, there were no differences in participation according to lunch price categories between the two foodservice systems. In both foodservice systems the majority of the participating students paid the full price for the lunch. Participation in the reduced-price category was five percent or less for elementary and secondary students in both foodservice systems.

On the average, there was little difference in the price charged for lunch according to grade level. Reduced price lunches averaged 16.1¢

for elementary students and 16.9¢ for secondary students (or an overall average of 16.3¢) and full price lunches averaged 46¢ for elementary students and 48.8¢ for secondary students (or an overall average of 46.6¢). Data also showed that the full price charged for lunches served to students in those schools with lunches prepared on site was slightly lower than in those schools with preportioned-delivered lunches (44.7¢ vs. 47.1¢ in elementary schools and 48.1¢ vs 49.5¢ in secondary schools, respectively).

Sixty-nine percent of the schools serving preportioned-delivered lunches received the lunches from a central kitchen within the school system, 19 percent of the schools received the lunches from a non-school source, and 12 percent of the lunches came from a combination of the two sources.

b. Nutrients in lunches as served

Calculated analysis of the data on the ten indicator nutrients and food energy in the lunches served showed that, in elementary schools, lunches prepared on site contained significantly higher levels of iron and food energy than lunches preportioned and delivered. However, a significant difference associated with the type of foodservice system was not found for any other nutrient. In secondary schools, there were no significant differences in the nutrients or food energy served in the two foodservice systems. Secondary students were served significantly higher levels of all nutrients (except vitamin A and calcium) and food energy than elementary students. On the average, approximately 39 percent of the calories were derived from fat in lunches served in both foodservice systems for both grade levels.

When the levels of nutrients and food energy in lunches as served were compared to the standard for both males and females in elementary schools, iron and thiamin were lower than the standard, food energy was significantly lower, and all other nutrients were significantly higher.

These lunches achieved the fat constraint of 40 percent for both males and females. Preportioned and delivered lunches served in elementary schools were similar to lunches prepared on site except that the level of food energy was lower and the iron level was significantly lower than the standard. In secondary schools, lunches prepared on site contained significantly less iron than the standard for both sexes. The thiamin content of these lunches prepared on site was significantly higher than the standard for females and significantly lower than the standard for males. Food energy was significantly lower than the standard for males but was higher than the standard for females. Preportioned and delivered lunches showed a similar trend for iron, thiamin, and food energy. With the exception of vitamin A, which was significantly higher in lunches prepared on site, levels for all other nutrients were significantly higher than the standard in both foodservice systems. The percentage of calories supplied by fat for both grade levels and both foodservice systems did not differ significantly from the constraint of 40 percent (ranging from 38.2 percent to 39.8 percent).

c. Nutrients in lunches as consumed

Nutrients in lunches as consumed were also analyzed according to foodservice systems, grade levels, and sex. Consumption data showed that lunches in elementary schools with on-site preparation furnished significantly higher levels of protein, fat, iron, thiamin, niacin, and food energy than preportioned-delivered lunches. In secondary schools with on-site preparation, lunches as consumed were significantly higher in protein and niacin and significantly lower in the percentage of calories supplied by fat than in those schools with preportioned and delivered lunches. However, significant differences were small. There were no significant differences for other nutrients when the two foodservice systems were compared. For both foodservice systems, lunches consumed by secondary students contained significantly higher amounts of all nutrients except vitamin A than lunches consumed by elementary students. Generally, nutrient levels in lunches as consumed did not differ according to sex; however, in elementary schools, lunches consumed by males provided significantly higher levels of protein, phosphorus, riboflavin, and food energy than lunches consumed by females.

Relative to the standard, elementary school lunches as consumed supplied levels of thiamin, iron, and food energy which were significantly less than the standard for both sexes in both foodservice systems. All other nutrients in lunches as consumed were significantly higher than the standards for males and females except vitamin A which was higher than the standard, although not significantly so.

For both foodservice systems, males in secondary schools consumed levels of thiamin, iron, and food energy that were significantly below the standard and levels of calcium and vitamin A that were not significantly less than the standard. Similar trends were noted for females except for thiamin which was lower than the standard for both foodservice systems, although not significantly so.

d. Food consumption

Food consumption was evaluated according to two statistical variables - food not consumed (plate waste) and the percent consumption of foods by the student. Results showed that milk had the highest percent consumption in both foodservice systems. Secondary students consumed a significantly higher percent of their milk than elementary students (93.2 vs 85.8). Foodservice systems had a significant effect on plate waste and percent consumption of cooked vegetables, potatoes/pasta, fruit, and bread. A significant effect on the percent consumption of raw vegetables was also observed. In all of these cases, on-site foodservice systems had less plate waste and a greater percent consumption than was observed in schools where lunches were preportioned and delivered. The data showed that male students ate significantly more of the meat, fruit, bread, milk and combination items than female students. When data on plate waste and percent consumption were adjusted for serving size, results showed that the serving size of all food items except milk and miscellaneous foods influenced the quantity of plate waste. In addition, adjusting for serving size caused a change in the effects of grade level, foodservice system and sex for some food categories. For instance, raw vegetables were no longer significantly affected by grade level.

Data on percent consumption of commonly served menu items--those menu items that were served in at least ten lunches--showed that of the three vegetables most frequently served (canned green peas, green beans, and corn), canned corn had the highest percent consumption for both grade levels and both foodservice systems. Among other menu items, flavored milk, pizza and fish portions had the highest percent consumption for both foodservice systems - from 90.6 to 93.4 percent in elementary schools, and from 89.3 to 98.9 percent in secondary schools. Generally, vegetables had the lowest percent consumption. A frequency distribution of percent consumption of selected items was examined for all students. Data showed a bimodal distribution, that is, either students consumed most of the item as served or they consumed very little of the item.

e. The Type A Pattern

Even though this study was not designed as an audit of lunches served in the NSLP, data were analyzed to determine the distribution of lunches that satisfied each component of the Type A Pattern. The analysis was based on minimum requirements and did not reflect the larger serving sizes recommended for older children; therefore, only elementary school data were presented. Milk was the only component that was routinely provided in amounts that were consistent with the pattern requirements.

In 28.6 percent of the total lunches, the serving size for the meat/meat alternate component was less than 80 percent of the requirement; 40.8 percent satisfied the requirement and in 14.6 percent, the serving size was greater than 119 percent of the requirement. In 23.5 percent of the total lunches, the serving size was less than 80 percent of the requirement for the vegetable/fruit component; 54.4 percent met the requirement and 31.4 percent or almost one-third of the total lunches contained greater than 119 percent of the vegetable/fruit requirement. While only 8 percent of the lunches met less than 80 percent of the bread requirement and 29.1 percent of the lunches were below this level for the butter/fortified margarine requirement, 66.8 percent and 47.2 percent of the lunches had serving sizes for bread and butter/fortified margarine, respectively, that were greater than 119 percent of the requirements.

Lunches which had serving sizes above 119 percent of the requirement for a given component were studied to determine the effect of the excessive serving size. Data showed that the extent to which the excess serving was consumed was dependent on the food category. Students usually ate most of the excess portions of meat/meat alternates, bread, and butter. However, the larger than required portions of fruits and vegetables compounded the large amount of plate waste in these food categories. These results indicate the need to exercise portion control, especially for fruits and vegetables.

From the limited data available in this study, the amount of training taken by menu planners had no apparent effects on plate waste or consumption of food. Lunches served to students in all schools were examined to determine if they completely met the Type A Pattern according to serving sizes. Data showed that only eight elementary schools and eight secondary schools completely met the specified serving sizes of all required components in the pattern. Lunches which fully met Type A requirements as served in elementary schools, had significantly higher levels of food energy, protein, fat, iron, phosphorus, thiamin, and niacin than lunches that did not completely meet the requirements. In secondary schools, lunches meeting requirements had significantly higher levels of food energy, protein, fat, calcium, phosphorus, and riboflavin than lunches not meeting requirements. The percentage of calories supplied by fat did not vary significantly from the maximum constraint of 40 percent.

IV. Departmental Approaches to Minimizing Plate Waste

The following actions are or have been taken by the Department to improve food consumption in the NSLP and thereby better reach the goal of the program which is "to safeguard the health and well-being of the Nation's children":

A. Proposed revisions in lunch pattern:

The Department recently completed a review of the Type A Pattern in cooperation with the Science and Education Administration, taking into account the 1974 revision of the RDA and new information on students' food consumption and eating patterns, food preferences, and problems schools encounter in the use of such patterns. This review has led to the development of proposed revisions in the lunch pattern which have been published as Interim Regulations in the Federal Register (August 22, 1978). These proposed revisions include (a) specifying quantities of food appropriate for five age groups, thereby allowing significantly smaller portion sizes for some foods for elementary school students while more accurately meeting the nutritional needs of children of all ages, (b) incorporating a greater number of conventional foods, such as rice, noodles, and macaroni-type products into the lunch patterns, thereby increasing flexibility, and (c) allowing individual children, ages 12 and over, to request smaller portion sizes of the required lunch component. This allows for differing food preferences of individuals

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and minimizes unnecessary food waste. In addition to these changes, the interim regulations require that School Food Authorities involve students in the program through activities such as menu planning, enhancement of foodservice environment, program promotion and related student-community support activities in an effort to increase food acceptability, participation, and nutrition awareness.

These regulations encourage School Food Authorities to (a) utilize the school foodservice program to teach students about good nutrition practices, (b) involve parents, teachers, faculty, and community in activities designed to enhance the program, and (c) provide a selection of foods and types of milk from which children may choose their lunch, whenever possible.

The interim regulations, incorporating public concerns expressed as a result of proposed regulations, permit optional testing of interim lunch patterns under actual operating experience. The tests include a voluntary field testing by School Food Authorities and a comprehensive evaluation by the Department using standardized methodology within sample schools. Data obtained from these evaluation activiites will assist the Department in finalizing regulations.

B. Offer versus serve provision:

The Department and the Congress, eager to improve consumption and to decrease food waste in the NSLP, initiated several actions with the objective of decreasing plate waste. On October 7, 1975, Public Law 94-105 directed the Secretary of Agriculture to establish, in cooperation with State educational agencies, "...administrative procedures, which shall include local educational agencies and student participation, designed to diminish waste of foods which are served by schools participating in the school lunch program...without endangering the nutrient integrity of the lunches...." Accordingly, NSLP regulations were amended through the addition of the "offer versus serve" provision. This provision allows senior high school students the latitude of choice indicated by law, while striving to maintain the nutritional integrity of the Type A lunch. The amendment states that senior high school students must choose a minimum of three of the five food items contained within the four food components of the Type A lunch.

In a further effort to reduce unnecessary food waste, the Department issued a final rule on June 16, 1978, that extends the "offer versus serve" provision of Public Law 94-105 to students in junior high and middle schools when approved by the local School Food Authorities. If local School Food Authorities permit, these students will have the same option to refuse part of the Type A lunch that the regulations presently allow senior high school students.

C. Regulations for competitive foods:

During the early part of 1979, the Department conducted public hearings on the question of banning the sale of candy and other competitive foods in schools. Based on comments given during the hearings, the Department will issue new proposals regulating the sale in school of competitive foods with little nutritional value. The new proposed regulations will replace the proposed regulations issued in the Federal Register on April 25, 1978 and withdrawn on December 15, 1978.

D. Methods of food preparation:

The Department has long encouraged on-site preparation of meals in schools. This has been supported by Congress in Public Law 95-166. This legislation puts a priority on federal foodservice equipment funds for (a) schools without facilities such as those schools not currently participating in the program, and (b) schools without facilities to prepare or receive hot meals, particularly where the food delivery system is contributing to food quality problems.

E. Training of school foodservice personnel:

The success of the NSLP in achieving its objective of serving nutritionally adequate, attractive lunches which school children will enjoy and consume depends in large part on the abilities of trained personnel responsible for the day-to-day activities of preparing and serving food and through the children's knowledge of foods needed for growth and development. Training in the Child Nutrition Programs has been a joint Federal, State, and local effort. The Food and Nutrition Service distributes basic program aids to assist school foodservice personnel in planning meals that meet the meal pattern requirements, in understanding the relationship of the meals to the dietary needs of children, and in following the proper food preparation and foodservice management techniques for operating an efficient school foodservice program. A portion of the Child Nutrition Program's Federal operating funds has been used to maintain the Food and Nutrition Information Center (FNIC) at the National Agricultural Library (NAL). FNIC serves as a resource for nutrition education and training materials for school foodservice personnel, State educational agencies and program cooperators.

Section 6(a)(3) of the National School Lunch Act authorizes funds for nutrition training and education, and studies and surveys. Funds for training in nutrition provide for: 1) cooperative and contractual agreements for nutrition training of school foodservice workers, and 2) grants to States. A television nutrition course "Food for Youth," a correspondence program consisting of eight courses for school foodservice managers, and a set of training manuals for school foodservice personnel have all been developed under FNS contracts with educational agencies and institutions. In 1972, a grant was awarded to North Carolina to develop standards for certification of school foodservice workers, to develop student training manuals, and to conduct training workshops for school foodservice personnel. In 1975, grants were awarded to New Hampshire, South Dakota, Wyoming, New Jersey, and Maine for projects to train school foodservice personnel. In these projects emphasis was placed on the development of education programs to motivate the employees to upgrade their knowledge and skills to attain competencies which will enable them to meet optional standards of performance. A reduction in plate waste was expected. In July 1977, grants were awarded to five States for training projects designed to increase participation in the school lunch and breakfast programs through more effective meal planning, preparation, and service and thus increase acceptance of meals offered at school.

F. Nutrition education:

Nutrition education in the Child Nutrition Programs has also been a joint Federal, State, and local effort. USDA has provided funds for nutrition education through grants to States. Some of these funds were utilized by the States to hire nutrition education specialists to develop and coordinate nutrition education programs in their respective States. Nutrition education curricula and materials were developed, tested, and implemented under other grants. Several of these grants investigated the relationship of nutrition education to plate waste. Data from these projects indicate that the implementation of a nutrition education program can help to reduce the level of plate waste in school meals.

Additionally, some of the projects demonstrated that nutrition education, correlated with the school lunch and breakfast programs, can result in positive changes in food habits. The projects used cafeterias as learning laboratories to teach students basic nutrition concepts emphasizing the nutritional goals of the NSLP and the School Breakfast Program (SBP). Data from four of these projects indicated a positive relationship between nutrition education and plate waste. In these brief pilot projects there were indications that ongoing nutrition education activities which utilize the school cafeteria as a learning laboratory can assist in changing students' attitudes toward foods and increasing their acceptance of food served in Child Nutrition Programs.

V. Conclusions and Recommendations

This report presents a review of current literature dealing with food consumption and the nutritional contributions of the NSLP. It also describes in detail the results of a Departmental study to determine the effects of the type of foodservice system on plate waste and nutritional characteristics of lunches served and consumed in schools in the program. Based on the results of the Food and Nutrient Consumption Study and other studies reviewed in this report, it can be concluded that in any group feeding situation, plate waste exists. The results are in general agreement as to the amounts and kinds of foods being wasted and the nutrients which are most often deficient in the lunches.

The literature review indicates that there are many factors which have an impact on the quality of food consumed by children participating in the NSLP. Some of these factors include the acceptability of foods in the menu, quality of foods purchased, quantity of food prepared, opportunity for choices of foods, methods of merchandising and service of foods, portion sizes, environment in which lunches are served and consumed, time allowed for eating, peer pressure, attitudes of teaching and administrative staffs, and knowledge of foods and nutrition on the part of the students.

Data from studies included in the literature review and the Department's study of food and nutrient consumption in the NSLP showed the following:

A. For those studies reporting consumption data for various food categories, milk (flavored and unflavored) had the highest acceptability and consumption rate of any food category. Raw and cooked vegetables were the least accepted and least consumed foods.

B. Most Type A lunches as served to students met or exceeded the standard of one-third the RDA for protein, calcium, phosphorus, vitamin A, riboflavin, and niacin. Most lunches were lower than the standard for iron and thiamin. Food energy was consistently below the standard. Most lunches achieved a percentage of calories from fat close to the specified constraint.

C. Nutrient levels that just met the standard in lunches as served were often lower than the standard in lunches as consumed because the lunches were not entirely eaten. Consumption levels of vitamin C, riboflavin, and niacin were adequate in most studies. Vitamin A, phosphorus, calcium, and protein were lower than the standard in several of the studies. Iron, thiamin, and food energy, which were low in lunches as served, were lower in lunches as consumed.

D. Lunches prepared on site in elementary schools in the Department's study had significantly higher levels of iron and food energy than lunches preportioned and delivered. For other nutrients in lunches served in elementary schools and for all nutrients in lunches served in secondary schools, there were no significant differences in levels of nutrients associated with foodservice systems.

Lunches consumed in elementary schools with on-site food preparation furnished significantly higher levels of protein, fat, iron, thiamin, niacin, and food energy than preportioned and delivered lunches. In secondary schools, on-site lunches were significantly higher in protein and niacin and significantly lower in the percentage of calories supplied by fat than lunches preportioned and delivered. These significant differences were small.

E. Relative to the standard used in the Department's Food and Nutrient Consumption Study, thiamin and food energy were significantly higher in elementary school lunches which completely met requirements of the Type A Pattern than in lunches that did not fully satisfy the requirements. In secondary schools, only food energy was significantly higher in lunches which completely met requirements.

The preparation and service of quality food in an institutional-type setting is a complex task. Data from the literature indicate that expertise in this area could be improved and the need for additional training of school foodservice personnel becomes apparent.

A basic objective of the NSLP has been to aid in the formation of good eating habits in the lunchroom, to the end that participating children will gain a full understanding of the relationship between nutrition and health. Given these objectives, some food waste in schools is inevitable as children are served nutritious foods that may differ from the foods these children are accustomed to eating. Nutrition education is necessary to minimize this food waste.

In an effort to improve food consumption in the NSLP, the Department has initiated and/or implemented many activities which include (1) proposing revisions in meal requirements, (2) implementing "offer versus serve" provisions, (3) proposing regulations concerning the service of competitive foods, (4) encouraging on-site food preparation, (5) implementing training programs for school foodservice personnel, and (6) implementing nutrition education programs.

In conjunction with these Departmental actions, additional steps are needed at local, State, and Federal levels if current rates of food consumption are to be increased. At the local level, school and district administrators must make a commitment to the program and support it through actions such as:

1. Involving students through activities such as menu planning, enhancement of the lunchroom environment, program promotion, and related student-community support activities.

2. Involving parents, faculty, and community in activities designed to enhance the program.

3. Scheduling lunch periods that minimize length of serving lines and provide sufficient time for students to eat lunch in a relaxed manner.

4. Encouraging teachers to eat with students, to the point of arranging for teachers to have their own free period after the students eat (especially important in elementary grades).

5. Planning for adequate supervision of the lunchroom.

6. Developing competency requirements for school foodservice personnel and allowing opportunities for in-service training programs, and

7. Providing menu choices to students so they may select foods they are willing to eat.

State School Food Authorities should emphasize the need for the above actions when working with school administrators and encourage their implementation. It is also necessary for States to plan and execute effective training programs for school foodservice personnel. State programs to certify school foodservice personnel and the development of training workshops are good examples of needed activities. State agencies must be adequately staffed with trained foodservice personnel to be able to assist schools in achieving a high quality foodservice.

Activities such as those discussed above require a total commitment on the part of State and local program administrators. An equal commitment is necessary at the Federal level. From the inception of the NSLP in 1946, the Department has taken a sincere interest in, and provided guidance for, school foodservice operations. Food buying guides, standardized recipes, and menu planning guides are evidence of this. As the program grew, the system to support the foodservice operations grew with it, keeping the balance of program administration and foodservice operations. The Child Nutrition Act of 1966 brought additional requirements and changes which resulted in an emphasis on program administration, but foodservice operations continued to command considerable interest. However, subsequent legislation created additional administrative demands on FNS and States, but staffing did not increase sufficiently to keep pace with these additional demands. Consequently, FNS and States responded to those program areas creating the greatest pressure -- administration (State plans, cost accounting, recordkeeping, free and reduced price meal accountability, etc.). The attention given to foodservice operations decreased accordingly.

The late Senator Humphrey stated publicly and for the record: "...we must increase our efforts to improve the quality and acceptability of food offered to children." This is the commitment required by all, a commitment which requires adequate resources and equal attention to both program administration and quality foodservice operations.

GLOSSARY

1. A la Carte Foods - any food item which is priced and sold separately from the Type A school lunch or school breakfast.

2. Average Daily Attendance - the total number of students attending school during a given period divided by the number of days school was in session during that period.

3. Average Daily Participation - the total number of students participating in the school's lunch program divided by the number of days school served lunches.

4. Base Kitchen - a kitchen that prepares meals for service within the facility in which the kitchen is located and for delivery and service at receiving schools.

5. Central Kitchen - a kitchen that prepares meals for delivery and service at receiving schools. Meals are not served at this facility.

6. Child Nutrition Programs - those USDA food assistance programs administered by the Food and Nutrition Service for eligible children of high school school age and under, including the National School Lunch Program, School Breakfast Program, Special Milk Program, Child Care Food Program and the Summer Food Service Program for Children.

7. Closed Campus - a campus where students must obtain permission to leave the school property during school hours.

8. Components of the Type A Lunch - the food groups specified in National School Lunch Program regulations as required components of the Type A Pattern. These specific components are as follows: meat/meat alternate, vegetable/fruit, bread/bread alternate, and fluid milk.

9. Free and Reduced Price Meals - a breakfast or lunch which, in the case of free meals, neither the child nor any members of his family pays; and in the case of reduced-price meals, the price of the meal will be less than the full price, and shall not exceed 10 cents for breakfast nor 20 cents for lunch. Neither the child nor any member of his family is required to work in the school or in the school's foodservice in order to receive free or reduced-price meals.

10. Full Price Meal - a meal served to a child in Child Nutrition Programs in which the child pays the full price. The cost of the meal to the child is defrayed in part by Federal assistance in the form of cash and commodities.

11. Grant - an agreement between the Federal Government and a State or local government whereby the Federal Government provides financial assistance to carry out specific programs or activities.

12. Grant Program - those activities and operations of the grantee which are necessary to carry out the purpose of the grant, including any portion of the program financed by the grantee.

13. School Breakfast Program - authorized by the Child Nutrition Act of 1966, as amended, to provide breakfast to children in all schools that desire to participate.

14. Meat Alternate - a food which fulfills the requirement for the meat/meat alternate component of the Type A lunch as an alternate to cooked lean meat. The kinds of meat alternates which may be used toward meal requirements are: cheese, egg, cooked dry beans or peas, and peanut butter. Textured vegetable protein enriched macaroni products with fortified protein and cheese alternate products can also be used toward the meat/meat alternate requirement.

15. National School Lunch Program - authorized by the National School Lunch Act of 1946, as amended, the NSLP is the oldest and largest of the Child Nutrition Programs. Its purpose is to help the States initiate, maintain and expand, nonprofit school lunch services in educational units of high school grade or under, operating under public or nonprofit private ownership in a single building or complex of buildings. The program offers a basic amount of financial assistance for each lunch served, technical assistance and guidance to establish and operate a program, and USDA donated foods or cash equivalent. These lunches must meet the requirements for a Type A lunch.

16. Nutrition Education Program (school food service related) - a nutrition education program included in the school curriculum designed to involve staff, students, teachers, parents, school foodservice managers and administrators, and the community in a cooperative effort to establish a foundation of nutrition knowledge, and to apply it.

17. Nutritional Goal for the School Lunch - the nutritional goal for the National School Lunch Program is to provide one-third of the Recommended Dietary Allowances (RDA) as established by the Food and Nutrition Board, National Research Council of the National Academy of Sciences for children of various age groups. This goal can be obtained by including the kinds and amounts of foods specified in the Type A Pattern and adhering to the Department's recommendations for planning menus.

18. On-site Foodservice System - meals are prepared in a kitchen in the school for service within the school in which the kitchen is located.

19. Open Campus - a campus where students are allowed to leave the school property without obtaining permission.

20. Preportioned-Delivered Meals - meals which have been preportioned into individual hot and/or cold packages and sent from a base or central kitchen or other off-premise food preparation facility to a receiving school for service.

21. Receiving School - a school that receives meals delivered from a base or central kitchen, or other off-premise food preparation facility for service. Meals may be delivered to the receiving school ready-to-serve, or in a form requiring heating, thawing or other final preparation.

22. Recommended Dietary Allowances (RDA) - levels of intake of certain essential nutrients considered by the Food and Nutrition Board, National Research Council of the National Academy of Sciences to be adequate to meet the known nutritional needs of practically all healthy persons. RDA are recommendations for the amounts of nutrients that should be consumed daily for the maintenance of good nutrition plus an additional safety margin to insure the needs of nearly all healthy individuals. They do not take into account special needs arising from illnesses and disorders which require special dietary treatment. RDA (1974 revision) are expressed in 17 different age-sex categories, since requirements for most nutrients vary with body size, differ from individual to individual, and are greater during periods of rapid growth, and during pregnancy and lactation.

23. Special Milk Program - designed to provide children with low cost fluid milk, the Special Milk Program reimburses schools, child care centers, settlement houses and summer camps for all or part of the cost of milk served. The program enables all paying children to purchase milk at a reduced price (below dairy cost). The program pays the full cost of milk (after discount) served to children who qualify for free milk under the income poverty guidelines.

24. Type A Lunch or Type A Lunch Pattern - a meal planned according to the Type A Pattern as specified in the National School Lunch Program regulations. The kinds and amounts of foods listed in the Type A Pattern are designed to provide a nutritious and well-balanced lunch daily to each child which, averaged over a period of time, will approximate 1/3 of the child's RDA.

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I. Purpose

Section 10 of Public Law 93-150, enacted in November of 1973, provides that:

> "The Secretary of Agriculture is authorized and directed to carry out a comprehensive study to determine if the benefits of programs carried out under the National School Lunch Act and Child Nutrition Act are accruing to the maximum extent possible to all of the Nation's school children,... The Secretary shall report his findings...."

As a result of this mandate, the United States Department of Agriculture (USDA) sent to Congress the "Comprehensive Study of the Child Nutrition Programs--July 1974" (1). One of the findings of the report was that relatively few carefully designed studies have been conducted to evaluate the effect of these programs on the dietary or nutritional status of participating children. Furthermore, a major area of concern for which there was sparse data available was the degree to which food is offered but not eaten. In view of these findings, USDA pledged to investigate the subject of plate waste.

The purpose of this study on food consumption in the National School Lunch Program (NSLP) was to: (1) conduct a comprehensive review of literature on plate waste in school foodservice and other institutional type foodservice facilities, (2) report the results of a pilot study designed to determine the degree of plate waste in the NSLP and its relationship to the nutritional benefits of the program, (3) define factors influencing food consumption as reported in the literature, (4) review actions taken by USDA to minimize plate waste, and (5) provide suggestions and recommendations for improving food consumption.

II. Introduction and Background

Section 2 of the National School Lunch Act defines the general purpose and scope of the NSLP and states in part:

> "It is hereby declared to be the policy of Congress, as a measure of national security, to safeguard the health and well-being of the Nation's children and to encourage the domestic consumption of nutritious agricultural commodities and other food by assisting the States, through grants-in-aid and other means, in providing an adequate supply of foods and other facilities for the establishment, maintenance, operation, and expansion of nonprofit school lunch programs."

The Act, passed in 1946, authorized the Secretary of Agriculture "... to prescribe lunches, based on tested nutritional research, that would meet a minimum nutritional requirement." To fulfill the requirement, the Type A Pattern, encouraged in 1944 by the War Food Administration was incorporated in the NSLP as one of the meal patterns prescribed as being acceptable as a basis for lunches for the schools and communities interested in starting a school lunch program. The Type A Pattern is still used as a framework for planning nutritionally adequate lunches and includes foods from the four food groups found in the Daily Food Guide (2). This food-based pattern is periodically reviewed and revised as new knowledge is gained about the nutritional needs, food consumption habits and preferences of children, how the pattern is used at the local level, and nutritional concerns of State agencies and local school districts. The nutrient goal of the current pattern is to furnish one-third of the Recommended Dietary Allowances (RDA) for boys and girls 10- to 12-years of age as established by the Food and Nutrition Board, National Research Council of the National Academy of Sciences (3). Quantities of food that must be served are specified to provide lunches that furnish this goal on the average over a week's time.

The RDA have been periodically revised since the initial publication in 1943. The revisions were based on new nutrition knowledge and/or a more accurate interpretation of existing data. As the RDA are revised, the Science and Education Administration (SEA) USDA, formerly the Agricultural Research Service, in conjunction with the Food and Nutrition Service, conducts a thorough review of the Type A Pattern to insure that the meal pattern continues to meet the nutritional goal. Revisions in the pattern are made, through the public rulemaking process, as necessary to maintain this goal. Current regulations for the NSLP specify that a Type A lunch for 10- to 12-year-old boys and girls shall contain a minimum of the following food components in the amounts indicated:

MEAT OR MEAT ALTERNATE

Two ounces (edible portion as served) of lean meat, poultry or fish; or two ounces of cheese; or one egg; or one-half cup of cooked dry beans or dry peas; or four tablespoons of peanut butter; or an equivalent of any combination of the above-listed foods. To be counted in meeting this requirement, these foods must be served in a main dish or in a main dish and one other menu item.

VEGETABLES AND/OR FRUITS

Three-fourths cup serving consisting of two or more vegetables or fruits or both. A serving (1/4 cup or more) of full-strength vegetable or fruit juice may be counted to meet not more than 1/4 cup of this requirement.

BREAD

One slice of whole-grain or enriched bread; or a serving of other bread such as cornbread, biscuits, rolls, muffins, made of whole-grain or enriched meal or flour.

FLUID MILK

One-half pint of fluid milk as a beverage.

In addition to these requirements, the Food and Nutrition Service recommends that "other foods" not part of the lunch requirements (such as rice, macaroni, crackers, etc.) be added as needed to complete lunches, to help improve acceptability and to provide additional food energy and other nutrients.

To help assure that all Type A lunches meet the nutritional goal, it is recommended that lunches include:

...a vitamin A vegetable or fruit at least twice a week.
...a vitamin C vegetable or fruit several times a week.
...several foods for iron each day.

It is also recommended that:

...Fat in the Type A lunch be kept at a moderate level.
...Iodized salt be used in preparing lunches.

Since younger children are not always able to eat the amounts specified in the Type A Pattern, the regulations permit serving these children lesser amounts of selected foods than are specified above. To meet nutritional needs of teenagers, the regulations encourage serving larger amounts of selected foods to older boys and girls. Recommended amounts of foods to be served in Type A lunches are shown in Table II-1.

III. Studies and Surveys

A review of the literature shows that many studies have been published over the past ten years which assess the NSLP. These studies have ranged in subject matter from an evaluation of the nutritive content of Type A lunches to a comparison of Type A lunches to lunches planned by alternative methods of menu planning, such as a nutrient standard method. Several studies have assessed other institutional foodservice programs. In these studies, varying amounts of data on food consumption have been included; however, data reporting amounts of plate waste by food component were minimal. Because of this lack of data on plate waste, the Department conducted a pilot study assessing food and nutrient consumption in the NSLP. As a part of the study, plate waste data were collected. A summary of studies reported in the literature, a review of school foodservice experiences and a report of the study conducted by the Department follows.

A. A Literature Review of Food Consumption and Nutrition Evaluations of the National School Lunch Program and Other Institutional Foodservice Programs

1. Food Consumption and Nutrition Evaluation in School Lunches--Studies Conducted or Financed by the United States Department of Agriculture

Table II-1 The Type A school lunch guide to the amounts of food for boys and girls of specified ages

Pattern	Pre school children (3 up to 6 years)	Elementary school (6 up to 10 years)	children (10 up to 12 years)	Secondary schools boys and girls (12 up to 18 years) 1/
Meat and/or alternate:			Type A Lunch	
One of the following or combina- quantities:				
Meat, poultry, fish	1-1/2 ounces	2 ounces	2 ounces	3 ounces
Cheese	1-1/2 ounces	2 ounces	2 ounces	3 ounces
Cooked dry beans and peas	1/4 cup	1/3 cup	1/2 cup	3/4 to 1-1/4 cups
Peanut butter	2 tablespoons	3 tablespoons	4 tablespoons	4 to 5 tablespoons
Vegetable and/or fruit 3/	1/2 cup	3/4 cup	3/4 cup	1 to 1-1/2 cups
Bread 4/	1/2 slice	1 slice	1 slice	1 to 3 slices
Milk	3/4 cup 5/	1/2 pint	1/2 pint	1/2 pint

1/ When a range in amounts is given the smaller amounts are suggested for girls and the larger for older boys. An amount midway between the amounts shown is suggested for younger boys.

2/ When egg is served as the main dish in the lunch, use in addition a half portion of meat or other meat alternate for all children except those 3 up to 6 years.

3/ Must include at least two kinds.

4/ Or a serving of cornbread, biscuits, rolls, muffins, etc., made of whole-grain or enriched meal or flour.

5/ If this is impractical, serve 1/2 pint.

REMEMBER: The amounts of foods for all age groups, except 10 up to 12 years are intended as guides and their literal use is not mandatory.

SOURCE: USDA - FNS P.A. No 719 (4)

(a) Nutritive Content of Type A School Lunches--Agricultural Research Service

In 1966, the Agricultural Research Service (ARS) (currently the Science and Education Administration) and the Consumer and Marketing Service, both of USDA, conducted a study of the nutritive content of Type A lunches served in 300 schools throughout the Nation (5, 6, 7). One of the objectives of the study was to determine the effectiveness of the Type A Pattern, as interpreted by foodservice personnel in meeting the nutritional goals of the program.

Four sample trays were randomly collected each day for five consecutive days during the sixth grade lunch period at each school. At the laboratory the edible portion of food was weighed and homogenized in a blender. One composite was made of the 20 lunches from each school. Samples were stored under frozen conditions until they were chemically analyzed for all nutrients for which there were known RDA (except vitamin C). Data were then compared with one-third and one-fourth of the 1968 RDA for 10- to 12-year-old children.

Results of the study indicated that, on the average, lunches as served in all schools achieved or exceeded the nutritional standard of one-third of the RDA for protein, vitamin A, thiamin, riboflavin, niacin, vitamin D, vitamin B^{12}, calcium and phosphorus. Lunches failed to achieve the standard most often for iron, vitamin B^6, magnesium and food energy. The average vitamin A activity was 2,100 I.U.; however, the vitamin A activity ranged from 380 I.U. to 10,300 I.U. More than one-third of the schools were below the standard of 1,500 I.U. Two-thirds of the lunches did not reach the nutritional standard for iron; one-half did not reach the standard for Vitamin B^6. Less than one-half of the lunches met the standard for magnesium. Ascorbic acid was not analyzed; however, based on a general assortment of vegetables and fruits served, the authors concluded that the three-fourths cup of vegetables or fruits as recommended would supply the 13 milligrams of ascorbic acid required to meet the standard of one-third of the RDA.

An Ad Hoc Committee was appointed by the Secretary of Agriculture for the purpose of: (1) Reviewing the nutritional standards or goals of the present Type A lunch and other Child Nutrition Programs and (2) Advising on criterion for updating the goal to keep it consistent with current nutritional knowledge and to keep it workable for a mass feeding program.

The recommendations of the study and the Ad Hoc Committee were to use the terminology "meat/meat alternate" in place of "protein rich food group" and to decrease the butter/fortified margarine requirement from two teaspoons to one teaspoon. These recommendations were implemented in June 1969.

Menu planning recommendations were revised to state that lunches should include "a vitamin A vegetable or fruit at least twice a week, a vitamin C vegetable or fruit several times a week, and several foods for iron each day."

(b) Comparison of Type A and Manual Nutrient Standard Menus and Correlation of Plate Waste and Acceptability in the National School Lunch Program -- Colorado State University

The extent of the flexibility of the Type A Pattern has been questioned in recent years and has resulted in studies which compare the Type A Pattern with other menu planning methods. In 1973, Harper and Jansen (8) from Colorado State University reported the results of their study comparing lunches planned according to the requirements of the Type A Pattern with lunches planned by a manual Nutrient Standard Method (NSM) for planning menus, which they developed. Two of the five objectives of this study that were pertinent to these discussions were: 1) to determine food acceptability, and 2) to analyze, by calculation, the nutrients as planned, served and consumed for the two menu planning methods.

The study, conducted in the Fall of 1972 and the Spring of 1973, included 57 elementary and secondary schools and approximately 2,300 fifth and tenth grade students--approximately 30 students per school. The school lunch supervisors from each school district planned menus for one elementary school and one high school. Both Type A and NSM menu planning methods were used in each school. For the NSM menu plan, components and/or amounts of foods were no longer required. Rather, the Food and Nutrition Service (FNS) specified a required minimum level of nutrients which were to be furnished by each menu. The NSM menus were based on standardized recipes which had been calculated to determine nutrients per serving, and were planned on a weekly basis to provide one-third of the RDA for food energy and nine nutrients and one-half of the RDA for protein. A specially designed abacus was used to tally nutrients of individual menu items when planning menus. A standard of one-third of the RDA was used for the Type A menus for comparison of nutrients.

Analysis of the nutrient content of the menus as planned was based on a four-week cycle. Data on serving size, plate waste, nutrients in lunches as served and consumed, and menu item acceptability were obtained during one week of the cycle.

Results of the study showed that there were no vast differences in the menu items used by the planners for the two menu planning methods. Analysis of the nutrients in menus "as planned" and "as served" showed that Type A and NSM menus for grades five and ten exceeded the nutrient standard on the average for protein, calcium, phosphorus, vitamin A, vitamin C, riboflavin and niacin (See Table III-1). Neither menu plan achieved the standard for iron, thiamin and food energy in foods as served. In both grades the NSM menus as planned were less than the constraint of 40 percent of calories derived from fat, however Type A menus exceeded the constraint. The differences were not significant.

Table III-1 Levels of nutrients in lunches as planned, served and eaten for both Type A and NSM for grades 5 and 10

BASIS	Kilo-calories		Protein gm.		Calcium mg.		Phosphorous, mg.		Iron mg.		Vitamin A I.U.		Vitamin C mg.		Riboflavin, mg.		Thiamin mg.		Niacin mg.		Fat %	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
GRADE 5 TYPE A																						
Planned	772	172	31.8	7.0	472	117	556	125	4.4	1.7	3040	2899	26.8	16.3	.81	.17	.41	.14	10.95	3.0	40.8	6.1
Served	659	149	28.9	7.0	448	98	517	118	3.8	1.5	2640	2083	22.6	12.2	.75	.13	.37	.14	9.7	2.9	42.2	6.0
Eaten	532	174	22.7	8.1	361	119	409	136	2.7	1.5	1578	1313	14.3	10.5	.61	.18	.28	.14	7.5	3.2	42.8	7.0
Standard	835		25		400		400		5.0		1500		13		0.43		0.43		5.7		40%	
GRADE 5 NSM																						
Planned	812	125	32.3	5.5	482	115	571	110	4.9	1.4	3208	2536	27.9	17.0	.81	.15	.43	.12	11.3	2.8	39.7	5.8
Served	764	135	30.9	6.0	449	92	542	102	4.5	1.3	2616	1973	24.9	15.9	.78	.12	.40	.13	10.7	2.8	38.9	6.0
Eaten	582	168	23.8	7.4	366	111	428	123	3.2	1.4	1529	1287	15.8	12.7	.63	.17	.29	.12	8.1	2.9	40.0	6.8
Standard	835		25		400		400		5.0		1500		13		0.43		0.43		5.7		40%	
GRADE 10 TYPE A																						
Planned	958	241	39.2	10.1	531	159	658	172	5.8	2.2	3743	3165	32.6	19.0	.94	.20	.53	.20	13.9	4.2	40.8	6.2
Served	873	194	36.8	10.3	512	134	625	142	5.2	1.9	3405	2869	28.2	15.6	.88	.16	.46	.15	13.0	4.8	40.8	6.4
Eaten	717	208	31.0	11.0	436	133	528	152	4.1	1.9	2018	1832	19.3	13.1	.76	.19	.37	.15	10.9	4.8	41.7	6.8
Standard	950		28		465		465		5.7		1665		17		0.48		0.48		6.3		40%	
GRADE 10 NSM																						
Planned	939	154	37.3	6.8	521	132	641	131	5.9	1.7	3901	3106	32.8	19.7	.90	.18	.50	.14	13.3	3.4	38.5	5.8
Served	900	174	36.8	8.4	527	152	649	167	5.6	1.9	3679	3904	31.9	21.0	.88	.17	.47	.15	13.0	3.6	39.5	6.1
Eaten	748	194	31.5	9.1	456	150	556	173	4.4	1.9	2475	3186	22.2	16.6	.76	.19	.38	.15	11.0	3.7	40.3	6.4
Standard	950		28		465		465		5.7		1665		17		0.48		0.48		6.3		40%	

Source: Harper and Jansen (8)

Analysis of lunches as consumed indicated that the fat constraint was not achieved in either grade by either menu plan. Nutrient levels in lunches as consumed by grades five and ten achieved the standard for phosphorus, vitamin A, vitamin C, riboflavin and niacin in both menu plans. For grade five, protein and calcium levels in lunches as consumed came close to the standard for both plans; in grade 10, the amount of protein exceeded the standard while the calcium came close to achieving the standard. Iron, thiamin and food energy were the nutrients which were most difficult to obtain in sufficient amounts. Considering both menu plans together, the lunches consumed by fifth grade students supplied, on the average, only 67 percent, 59 percent, and 66 percent of the nutrient standard for food energy, iron, and thiamin, respectively; lunches consumed by the tenth grade students supplied only 77 percent, 75 percent and 78 percent respectively, of the nutrient standard for these nutrients. In both grade levels the calories derived from fat in the NSM lunches and Type A lunches as consumed were less than the constraint of 40 percent.

Food acceptablity ratings were reasonably well correlated with actual consumption. Students preferred individual food items to items which contained two or more food items with the exception of ethnic foods such as tacos, pizza and lasagna. Entrees without vegetables and baked items had higher consumption and acceptability rates than did soups, salads, vegetables, and entrees with vegetables. No significant differences were found in either the acceptability rating or consumption, as a function of menu planning technique.

Consumption data from the NSM and Type A lunches were combined and analyzed to determine the extent of plate waste by menu item and menu category (9). Table III-2 shows the results. The consumption of milk was 88 percent and 94 percent in the fifth and tenth grades, respectively. Consumption of entrees ranged from 67 percent to 83 percent in the fifth grade and 68 percent to 91 percent in the tenth grade. Starches (rice, pastas, etc.) were consumed at a comparable rate. Approximately one-half of the vegetables and salads served in both grades were consumed, while the consumption of fruit, fruit-desserts and juices was approximately 70 percent. The consumption of other types of dessert items ranged from 61 percent to 93 percent in the two grades.

For individual schools, overall food consumption ranged from 55 to 90 percent. The authors suggested that "the upper level of this range is attainable for most schools if proper attention is paid to good foodservice management practices."

(c) Pilot Study to Compare Type A Lunches with Alternative Subsidized Lunches Among High School Students -- Colorado State University

In 1977, Colorado State University, under contract with USDA investigated several alternative approaches to menu planning which could possibly increase the acceptability of the meals served in high schools thereby

Table III-2 Percentage of food consumed for major menu groups 1/

Menu Item Group	5th Grade	10th Grade
Chicken and Turkey	75.6±0.8 2/	84.7±0.6
Fish	82.6±0.9	91.0±0.8
Beef	78.9±0.5	88.7±0.4
Pork and Veal	66.7±2.4	87.2±1.4
Cheese and Egg	72.7±1.4	76.1±1.2
Beans	67.8±1.0	68.0±1.2
Combination Dishes	74.6±0.6	87.7±0.4
Franks and Sausages	81.2±0.9	88.2±0.9
Bread, Cereal Products, Chips	77.9±0.4	83.7±0.4
Potatoes and Rice	72.2±0.6	83.9±0.5
Green Beans, Peas, Corn	55.4±0.6	62.0±0.7
Other Vegetables	35.2±0.7	41.7±0.8
Cakes, Pies, Doughnuts, Sweet Rolls	77.9±0.6	80.1±0.6
Other Baked Desserts	61.3±1.3	70.3±1.5
Ice Cream and Sherbert	93.3±0.8	92.0±1.0
Fruit, Desserts and Juices	71.9±0.5	68.6±0.6
Puddings, Custard, Gelatin	71.0±1.1	69.5±1.2
Cookies and Candies	83.9±0.6	83.5±0.7
Soups	54.0±2.1	68.9±2.5
Salads	53.1±0.4	54.8±0.5
Sandwiches	69.1±1.2	75.1±1.1
Milk Beverages	87.8±0.2	94.3±0.2

1/ Consumption data from the NSM and Type A lunches were combined and analyzed.

2/ Mean ± standard error

Source: Jansen and Harper (9)

increasing student participation and decreasing plate waste among students (10). To provide valid information for making recommendations concerning alternative meal patterns, the Type A meal pattern with the "offer versus serve" provision (TAOS) was compared to three alternative patterns in 48 high schools. The "offer versus serve" provision permits students to choose a minimum of three of the five food items contained within the four food components of the Type A lunch. The objectives were to audit, assess and compare TAOS with three alternative patterns regarding (1) nutrients served and consumed, (2) amounts of plate waste and (3) degree of student satisfaction.

The three alternative meal patterns selected for comparison with TAOS were: (1) Type A (TA) - students were required to select all five components of the Type A Pattern, (2) Basic Four (BF) - students selected foods from the basic four food groups and (3) Free Choice (FC) - students had free choice in selecting lunches from a la carte items. The 48 schools had on-site kitchens and served menu choices so that students could select from a variety of menu items. For milk, the number of choices was governed by the previous school policy for types of milk offered.

The study was conducted in two phases. During the four week period of Phase I, all schools served lunches fulfilling the requirements for TAOS. For Phase II, the schools were randomly selected to serve one of three alternative meal patterns for six weeks. During each phase, food cost, non-food cost, and student participation data were collected for four weeks. For one week during each phase, data were collected on serving sizes of each menu item, recipes, student food selection, plate waste, and labor utilization. In addition, data collectors interviewed students and school lunch managers and subjectively evaluated the lunch program at the test school.

Results of the study showed that the nutrient levels in lunches as served were not significantly different in Phase II when the alternative patterns were served than in Phase I with TAOS. The nutritional value of meals selected in the FC meal pattern did not differ significantly from meals served in other patterns. The percent of calories provided by fat remained fairly constant at 37-39%. Analysis of lunches as consumed showed similar results for the nutritional value. There were no significant differences in the nutrient levels in lunches consumed in Phase II than in lunches consumed during Phase I. Again, the percentage of calories provided by fat remained constant at 37-39%.

Nutrient levels in lunches as served and as consumed by boys and girls were compared to nutrient standards for boys and girls of high school age. In lunches consumed by boys, food energy, iron and thiamin were significantly below the standard in all groups of both phases with one exception - thiamin in FC lunches of Phase II. For girls, iron was the only nutrient significantly below the nutrient goal in the lunches consumed by all groups in both phases.

Plate waste was calculated for 16 food categories both in absolute amount and as percentages of food served. In absolute terms, plate waste was not significantly different in Phase II than in Phase I for any food category or for total food. Overall food waste for all schools and both phases was 10% for boys and girls combined. When waste was expressed as percentages of food served, the change from TAOS to FC significantly reduced total food waste for both boys and girls. No significant change in percentage waste was associated with the change to either TA or BF. For both boys and girls in the three meal patterns, milk had the highest percent consumption (96-98% for boys and 92-95% for girls) and salads and vegetable, had the lowest consumption (72-88% for boys and 54-83% for girls). Girls consistently wasted more food overall than boys (13% and 7% respectively).

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Data from student interviews showed that student participation increased during Phase II when the alternative patterns were served. Participation in FC lunches increased 40% over Phase I and was one of the major reasons why labor cost dropped significantly for FC meals. Based on overall data, it appeared that the student preferred the FC meal pattern, felt the BF meal pattern was no different from TAOS and felt TA was less desirable than TAOS. Students indicated a preference for more fresh fruits or vegetables and less cooked vegetables on the menu.

(d) Comparison of Type A Pattern and Nutrient Standard Menus -- Memphis City School System and Dade County Public School System

Food service administrators have turned to the computer for a different approach to planning menus, calculating nutritive values, and controlling cost. In recent years, this new approach to menu planning has been studied for its possible use in the school foodservice system. The Memphis City School System, Memphis, Tennessee, and Dade County Public School System, Miami, Florida (11, 12) recently published the results of studies comparing the Type A Pattern as a method of planning menus to the Computer-Assisted Nutrient Standard (CANS) method of planning menus. In each study, ten schools in each school system served menus planned according to the Type A Pattern and ten schools served CANS menus.

The menus as planned were to provide approximately one-third of the RDA for food energy, vitamins and minerals and one-half of the RDA for protein. CANS menus were planned to meet a predetermined nutrient standard rather than to furnish specific amounts of food from particular food groups. In both studies, three major questions were addressed: (1) Were students served and did they consume food which furnished one-third of the RDA for boys and girls 10- to 12- years old? (2) Were the combinations of menu items acceptable to the student? (3) Which menu plan was most manageable in terms of time and cost? Each study was divided into three parts: (1) management, (2) acceptability and (3) nutrient analysis on a calculated basis of food energy and ten key nutrients plus the constraint of not more than 35 percent of calories derived from fat.

Memphis:

The Tennessee study was conducted in 1973. Data were collected from 989 fifth grade students. The nutritional analysis (calculated) was based on lunches planned, served and consumed during a 10-day period. Acceptability data were also collected during this time. Table III-3 shows the nutrient data on a weekly basis. There were no significant differences in the nutrient content of the menus as planned. Both Type A and CANS menus as planned met or exceeded the standard for all nutrients. Neither menu plan, however, satisfied the constraint for fat; that is, they exceeded the standard used in this study of not more than 35 percent of the calories derived from fat.

Table III-3 Levels of nutrients in lunches as planned, served to and consumed by students in Memphis City Schools serving Type A and CANS lunches

MENU		ENERGY (K cal)	PROTEIN (Gm)	FAT (Gm)	CALCIUM (mg)	IRON (mg)	PHOSPHORUS (mg)	VITAMIN A (IU)	THIAMIN (mg)	RIBOFLAVIN (mg)	NIACIN (mg)	VITAMIN C (mg)	CAL/ FAT
Type A	Goal	835.0	25.0	34.0	400.0	5.0	400.0	1500.0	0.43	0.43	5.7	13.0	35.0
	Planned	920.0	33.6	42.5	505.8	5.1	602.0	3118.7	0.46	0.90	12.0	31.7	41.7
	Served	679.5	26.2	28.8	402.5	4.1	475.4	2257.8	0.37	0.72	9.5	26.4	42.4
	Consumed	570.7	22.4	27.0	351.4	3.3	408.1	1689.1	0.31	0.62	8.0	20.0	42.6
CANS	Planned	923.0	35.0	38.8	474.0	5.1	588.0	3049.8	0.50	2.27	13.3	45.8	37.9
	Served	761.8	28.7	31.9	404.2	4.3	495.5	2168.3	0.42	1.73	11.1	44.8	37.6
	Consumed	557.1	21.4	23.8	325.5	2.9	379.2	1254.7	0.29	1.34	8.0	28.9	38.4

Source: Memphis City Schools (11)

Because lunches served did not always furnish the exact type or amounts of foods planned for in the menu, several lunches as served fell short of the required amount of some nutrients. Food energy was low and iron and thiamin were the nutrients with the greatest deficiency in both Type A and CANS lunches as served over the test period. Protein and calcium levels were above the standard in both menu plans. There were significant differences between CANS and Type A lunches as served for levels of protein, riboflavin, niacin, vitamin C, food energy and percent of calories derived from fat. The CANS lunches had higher values in every category except calories derived from fat, which had the desirable lower value. When nutrient intake was calculated for each nutrient, students served CANS lunches had significantly higher intakes of vitamin C, riboflavin, and a smaller percent of calories from fat than did students who were served Type A lunches. For the remaining nutrients, intake levels were higher for students who were served Type A lunches because larger amounts of Type A lunches were consumed than CANS lunches.

An analysis of the data showed that acceptability rates paralleled consumption. Milk had a high acceptability rating and high consumption. In schools with the Type A lunches, 79.9 percent of the students in the survey drank all of their milk; in schools with CANS lunches 73.6 percent of the students in the survey drank all of their milk. Sloppy Joes and hamburgers also had high acceptability ratings and high consumption. Approximately 93 percent of the students served Type A lunches ate 80-100 percent of the Sloppy Joe; approximately 93 percent of the students served CANS lunches ate 80-100 percent of the hamburger. Green beans had low acceptability ratings and were the least consumed. Fifty-three percent of the students in schools serving Type A lunches ate less than 50 percent of the green beans; in schools serving CANS lunches 55 percent of the students ate less than half of the green beans. Overall, raw and cooked vegetables had the lowest percent consumption.

As the menus were planned, there was no significant difference between the food cost of the two menu plans. However, as served, the Type A lunches cost significantly less than the CANS lunches. There was only a slight difference in labor cost.

Dade County:

The Florida study was conducted in the Spring of 1973 and through the 1973-4 school year and included 1,190 fifth grade students. The nutritional analysis (calculated), was based on lunches planned, served and consumed for one week during the test period. Acceptability data were also collected during this period. Table III-4 shows the nutrient data of lunches as planned, served, and consumed for one week. For all schools, both Type A menus and CANS menus were deficient in food energy as planned; Type A menus were deficient in iron. CANS menus had significantly higher levels of protein, iron, vitamin A, thiamin, riboflavin, niacin, vitamin C, and food energy as planned, than did the Type A menus. Fat exceeded the constraint to a greater extent in Type A menus than in

Table III-4 Levels of nutrients in lunches as planned, served to and consumed by students in the Dade County Public Schools serving Type A and CANS lunches

MENU		ENERGY	PROTEIN	FAT	CALCIUM	IRON	PHOSPHORUS	VITAMIN A	THIAMIN	RIBOFLAVIN	NIACIN	VITAMIN C	CAL/FAT
	Goal	835.0	25.0	34.0	400.0	5.0	400.0	1500.0	0.43	0.43	5.7	13.0	35.0
	Planned	731.8	29.9	33.9	473.1	4.3	535.2	2741.8	0.41	.77	10.6	41.2	41.7
Type A	Served	563.1	23.6	25.8	385.6	3.2	426.0	2083.4	.32	.63	8.3	30.9	41.4
	Consumed	452.2	19.3	20.8	319.6	2.4	351.2	1146.7	.25	.52	6.6	22.4	41.4
	Planned	816.5	32.2	33.5	453.8	5.0	546.1	3454.0	.45	.82	11.6	38.4	36.9
CANS	Served	621.0	24.5	25.9	372.9	3.6	428.0	2715.6	.34	.65	8.6	30.7	37.6
	Consumed	483.2	19.3	20.4	293.7	2.6	339.1	1203.5	.26	.51	6.7	19.7	38.1

Source: Dade County Public Schools (12)

the CANS menus as planned.

Analysis of lunches as served indicated that phosphorus, vitamin A, riboflavin, niacin and vitamin C most consistently exceeded the standard for each menu plan, while protein and calcium came close to meeting the standard. Iron and thiamin were the most deficient nutrients in each plan with food energy also being low. The fat content of lunches exceeded the nutrient constraint of 35 percent of calories derived from fat in each plan. As served, iron, vitamin A and food energy levels were significantly higher in the CANS lunches than in the Type A lunches; however, food energy and iron were still lower than the standard.

Data showed that those nutrients that exceeded the standard in lunches as served came close to the standard or exceeded the standard in lunches as consumed, especially riboflavin, niacin and vitamin C. Of all the nutrients calculated, iron was the lowest in lunches as consumed as a percentage of the standard. Calcium intake was significantly higher in schools with Type A lunches than in schools serving CANS lunches; iron and food energy intake were significantly lower. The percentage of calories obtained from fat in lunches as planned, served and consumed was significantly lower in the CANS lunches than in the Type A menus.

Total consumption and acceptability rates were higher in schools serving Type A menus than in schools serving CANS menus. Milk had one of the highest consumption and acceptability rates. In the schools serving the Type A lunches 83.6 percent of the students drank 80-100 percent of their milk. In schools serving CANS lunches, 78.6 percent of the students drank 80-100 percent of their milk.

Menu items in the meat/meat alternate category were well consumed in both menu plans. In schools serving CANS lunches, data for seven of the eleven meat items served showed that 75.8 to 84.3 percent of the students ate between 80 and 100 percent of these items. In schools serving Type A lunches, consumption data showed that for seven of the eleven meat items served, 81.1 to 95.6 percent of the students ate 80 to 100 percent of these items. Raw and cooked vegetables, except cooked corn (in schools serving Type A lunches) potatoes and pasta had low acceptability ratings and correspondingly low consumption in both menu plans. Data showed that in schools with CANS menus, 48.5 to 85.8 percent of the students ate less than 50 percent of their raw vegetables; 36.7 to 96 percent of the students ate less than 50 percent of their cooked vegetables. In the schools with Type A menus, 30.9 to 80.8 percent of the students ate less than 50 percent of their raw vegetables; 50.8 to 93.8 percent of the students ate less than 50 percent of their cooked vegetables.

Cost analysis showed that labor cost, food cost and total cost per lunch were not significantly different for the two menu plans. The average cost of a CANS lunch was 54 cents and the cost of a Type A lunch was 55 cents.

(e) Evaluation of Food Delivery Systems in School Food Service--Colorado State University

In 1976, Harper and Jansen (13) reported the findings of a pilot study to assess, audit and evaluate food delivery (foodservice) systems in 16 elementary schools. Objectives of the study were: (1) to assess and compare the nutritional quality of ten specific food items used by the schools as affected by the various foodservice systems, and (2) to assess the microbiological content of foods prepared, processed or handled by various foodservice systems in order to determine the degree of contamination, if any. Acceptability and cost factors were also measured.

Four foodservice systems were investigated among the 16 schools included in this study. The foodservice systems studied included: (1) on-site preparation and service, (2) central preparation with hot bulk delivery, (3) central preparation with chilled preportioned delivery and (4) frozen preportioned delivery. This study was designed to provide an analysis of differences between systems. Because of the small sample size and the design of this study, the results cannot be considered representative of individual foodservice systems.

Each of the schools served 10 specified menu items during the week of the test. For the nutritional evaluation, nutrients were chemically analyzed for selected lunch items at specific points of food production, delivery and service. Nutrients selected for evaluation were those most likely to be present in each particular food and which were known to be sensitive to heat, light, oxidation, and pH. For the microbiological quality evaluations, testing was made for total plate count and coliform groups for each point in food production, delivery and service. Points for collecting food samples and data, such as time and temperature, were established according to the characteristics of the foodservice system.

Food acceptability was determined by establishing the average portion size as served and weighing the edible portion of each test menu item remaining on the trays of 50 students age 10 to 12 years in each school. From these data, the average amount of food consumed was calculated. Additionally, costs associated with each foodservice system were identified based on food, physical facilities and equipment, labor cost and overhead.

The findings showed that for the specific test menu items used in the study there was considerable sample to sample variability in nutrient content which appeared to be associated with differences in ingredients and recipes used in food preparation as well as foodservice conditions. For this reason, nutrient levels associated with different foodservice systems were rarely significant, but for most nutrients in most foods, school to school variations were typically significant. These results suggest that the four foodservice systems are all capable of preparing food having comparable nutritional value. School to school variability indicated a need for training of school foodservice personnel in production methods to deliver food of highest possible nutritional value.

The foodservice system did affect the acceptability of the menu items served during the test. Acceptability was defined as the percentage of the average serving which was consumed. In assessing acceptability, data showed that substantial variability in serving sizes existed among schools. Since it was conceivable that the size of the serving may affect the acceptability of the menu item, an analysis of covariance was conducted to account for the variation in serving sizes. Results showed that the correlation coefficient between serving size and waste was high in ground beef and spaghetti, but quite low for all other test menu items. When the means for acceptability were adjusted for the effect of serving size, the acceptability of ground beef and spaghetti, boiled peas, chocolate pudding, and baked beans varied significantly depending upon the foodservice system. (See Table III-5.) Overall, lunches prepared and served on site had higher acceptability than chilled or frozen preportioned-delivered lunches. A variety of factors appeared to be responsible for these differences, including appearance of foods, monotony of menus, food preparation difficulties, taste of foods, portion size and overall lunch quality, as well as lack of student interaction with foodservice personnel.

Microbiological data, including counts of organisms which indicate contamination, poor sanitation, mishandling, and time-temperature abuse, were collected on all samples. Based on these data, all foodservice systems tested were capable of producing a microbiologically safe lunch and were not significantly different. School to school variability was large and potential food safety hazards resulting from poor quality raw ingredients, lack of sanitation, recontamination of food and time-temperature abuse were found in all systems. The authors concluded that to assure a safe school food supply, foodservice personnel need to be more adequately trained in foodservice sanitation and food safety. Furthermore, more definitive foodservice sanitation specifications should be developed.

No significant difference in total lunch costs as a function of foodservice systems was found when appropriate costs for space and equipment were included in the cost of the lunch. Miscellaneous costs varied considerably between schools, partly because accurate and standardized cost accounting procedures were not uniformly adopted.

(f) Evaluation of School Lunch and School Breakfast Programs in the State of Washington -- Washington State University

Washington State University conducted a comprehensive study evaluating the effects of the NSLP and School Breakfast Program (SBP) on ethnic groups of children in different geographic areas within the State of Washington during 1972 and 1973 (14). Data were collected from a total of 1,013 Black, Mexican-American and White students, most of whom were

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Table III-5 Percent consumption of selected menu items by delivery system

	Ground Beef & Spaghetti	Oven-fried Chicken	Fish Sticks	Meat Loaf	Baked Beans	Mashed Potatoes	Peas	Carrots	Peaches	Chocolate Pudding
On-site	83	89	91	80	81	76	69	48	92	88
Central/Hot Bulk Delivery	88	88	89	77	57	66	40	38	82	70
Central/Chill Preportioned Delivery	76	80	81	73	60	79	34	28	63	73
Frozen Preportioned Delivery	73	89	79	76	17 1/	60	20	26	70	96

1/ Results may be atypical since only two schools were able to serve baked beans.

Source: Harper and Jansen (13)

between the ages of 8 and 12 years. The data included anthropometric measurements, physical manifestations of malnutrition, biochemical parameters of nutritional status, and dietary intake.

To determine total dietary intake, students were interviewed in the classroom three different times to obtain 24-hour dietary recalls. During these interviews they were asked to describe all foods eaten during the day prior to the interview and to estimate the amount of each food or drink consumed. Food models were used as a guide for the quantity of food consumed.

Data on the contribution of the school lunch toward total nutrient intake and RDA were based on observations of children who ate school lunch on at least one of the days they completed a 24-hour recall. The nutritional values of the foods eaten were calculated using values given in standard reference materials for food energy, protein, calcium, phosphorus, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid.

Data on the daily dietary intake of the participants showed that: (1) Diets were below the RDA for food energy, but above the RDA for protein for all children; thiamin intake was adequate and there were few problems concerning riboflavin and ascorbic acid intake. (2) Age and sex were the critical factors influencing iron intake; both males and females in the 11- to 12-year-old group were below 100 percent of the RDA for iron, (3) Age and ethnic background influenced calcium and vitamin A intake; boys and girls in the 11- to 12-year-old group were below the RDA for calcium. Mexican-Americans had the lowest intake of calcium; white children had the highest calcium intake. Vitamin A intake was below the RDA for males 11- to 12-years-old. Mexican-American children, especially the boys, had the poorest dietary intake of vitamin A. Black students had the highest level of vitamin A in their diets, and (4) For food energy and 7 of the 9 nutrients, white children had significantly higher intakes (as a percent of RDA) than black and Mexican-American children. The exceptions were vitamin A and ascorbic acid for which Black children had the highest intake. Mexican-American children had the lowest intakes for food energy and all 9 nutrients.

Data on the nutrient contributions of school lunches showed that NSLP participants living in below-poverty families obtained more food energy and 7 of 9 selected nutrients from school-provided meals than did those from above-poverty households. Overall, the school lunch contributed between 28 and 47 percent of the total daily food energy and nutrient intake of participating children. Mexican-American children received a larger percentage of their daily intake from the school lunch than did other children. The school lunch contributed smaller percentages of the total iron intake than for other nutrients for all ethnic groups.

The highest contributions were for calcium, vitamin A, riboflavin, protein and phosphorus. For these nutrients, all ethnic groups received one-third or more of the RDA from the NSLP.

Table III-6 shows that lunches served in the NSLP contributed one-third or more of the RDA for protein, calcium, phosphorous, vitamin A and riboflavin. For ascorbic acid, black children failed to achieve this criterion. The percentages for food energy, iron, thiamin and preformed niacin ranges from 21 to 32 percent of the RDA. Black children had significantly lower levels of food energy and each of the 9 nutrients than the other ethnic groups, Mexican-American children did not differ from the white children in the proportions of calcium, iron, vitamin A, and riboflavin. For the other nutrients, there were significant differences between the percentages of the RDA contributed to the ethnic groups.

Table III-6 Percentages of the RDA for energy and nine nutrients contributed to ethnic groups by school lunch

	Ethnic Groups		
	Mexican-American	White	Black
Number of Observations per Group	214	262	207
Percentage of RDA:			
Food Energy (K calories)	29	27	24
Protein	72	64[1]	55
Calcium	39	40	36
Phosphorus	50	47	41
Iron	29	29	24
Vitamin A	45	47	38
Thiamin	28	37	22
Riboflavin	53	52	45
Niacin (preformed)	32	27	21
Ascorbic Acid (vitamin C)	40	36	30

[1] Mean percentages underlined within brackets do not differ significantly by Duncan's multiple range test, $\alpha = .05$.

Source: Price (14)

(g) Studies in School Lunch Waste: A Literature Review and Evaluation -- Georgetown University

In 1975, Altschul (15) reported the findings of a comprehensive review of the latest information available on food waste associated with school lunch and other institutional type foodservice. The specific objectives of his review were: (1) to present the "state of the art" regarding the severity of the food waste problem, (2) to identify factors that affect the amount of plate waste, (3) to interpret the effect of nutrition education on the amount of plate waste, and (4) to present recommendations to minimize the amount of plate waste in the National School Lunch Program.

In discussing the state of available information, Altschul reported that one of the difficulties in comparing the studies was the different terminology used from study to study. For example, in several studies, waste was equated with lack of acceptability. In other studies, participation was correlated with cost and waste; the assumption was that the greater the participation, the less the waste. As a result of this dissimilarity, it was difficult to generalize from one situation and its characteristics to another. Other difficulties encountered included the experimental design and methodology. Experimental designs could not be replicated and different methods were used throughout. Oftentimes, the published data were not definitive.

In the review, several studies were reported which gave figures associated with overall plate waste for the total meal and/or meal components such as meat, milk, vegetables, fruit and bread. In the first of two studies reporting overall plate waste, Martin (16) investigated the attitudes of students toward hot and cold lunches as measured by consumption. Plate waste for the elementary students ranged from 16 to 20 percent of the total lunch and for the secondary students, from 10 to 11 percent.

In the second study, Consolazio et. al. (17) showed plate waste figures of 14.5 to 15.3 percent from data collected as a part of a study evaluating the adequacy of rations fed to military personnel.

Walling (18) conducted a study on plate waste in the Albuquerque Public Schools, and found an overall plate waste of 25.1 percent. For individual items, Walling reported a waste of 12.7 percent for meat, 52.5 percent for vegetables, 29.4 percent for fruits and 5.8 percent for milk. The percentages of waste were the same in the elementary, junior, and senior high schools.

Doucette (19) surveyed schools in Hawaii and recorded the percentages of senior high school girls (612) and boys (812) who ate all, part, or none of the food served in four food categories. These results are shown in Table III-7.

Table III-7 Percentage of senior high school girls and boys who ate all, part, or none of the food served in the vegetable, meat, milk and fruit categories

	Girls			Boys		
	All	Part	None	All	Part	None
	Percent					
Vegetables	25	33	42	62	16	22
Meat	52	38	10	93	5	2
Milk	79	11	10	96	1	3
Fruit	35	20	45	64	12	24

Source: Doucette (19)

Twenty-two to 45 percent of the children did not consume any of their vegetables and fruits as compared to 2 to 10 percent of the students who did not consume any of their milk and meat. In all categories, a higher percentage of girls than boys ate part or none of the foods served. Portion sizes and "second helpings" were not considered in this study. Altschul commented that this was a problem common to all the studies reported in the review.

In a study designed to determine changes in plate waste after nutrition education (20), plate waste data were collected from control students and test students before and after a nutrition education program. Table III-8 shows the results.

Table III-8 Comparison of amount of school lunch plate waste by weight from nutrition education and non-nutrition education students before and after the nutrition education program

	BEFORE		AFTER	
	Test Group NE 1/	Control Group NEC 2/	Test Group NE	Control Group NEC
	percent			
5th graders	15.5	10.3	10.5	14.3
" "	31.3	33.3	22.6	28.1
7th graders	18.6	16.0	18.0	15.3
" "	22.7	24.6	25.1	24.1
10th graders	12.6	11.7	15.5	11.7

1/ NE = Nutrition Education
2/ NEC = Non-nutrition education

Source: Head (20)

After reviewing the study, Altschul wrote:

> "This study suggests that, in addition to the fact that nutrition education might reduce plate waste, it seems to be most effective in the younger grades of children thereby giving credence to the idea that education in habits relating to life situations should be started as early as possible in a child's life."

From the studies reviewed, Altschul identified three main categories of conditions that give rise to the incidence of plate waste: food served, logistics of the food service, and personal/social aspects. The findings were summarized as follows:

(1) Food factors included familiarity of the food offered, choice of foods, portion sizes and health status of students (allergies and lactose intolerance). In a study of plate waste and vegetable acceptance among fourth grade students, Hunt et. al. (21) introduced several vegetables that had been selected as being the least familiar to the children and their families. An educational program was presented which discussed how the vegetables were grown and the different ways of preparing them. A post-test showed that more children than parents like the previously unfamiliar vegetables. After the education program, plate waste was 2.9 percent of the total food served. In a resurvey of these students 1-1/2 years later, plate waste measured 7.5 percent of the total food served. Pretest figures were not given so there was no way to gauge whether the program had an immediate positive or negative effect on behavior. From the data, Altschul concluded that exposure to previously unfamiliar food items increased awareness of their potential palatability, but also solidified likes and dislikes.

Doucette (19) reported a kind of selective plate waste pattern among high school girls that approached "goal oriented" behavior. Girls were inclined to discard starch and bread items with the notion that this type of food selectivity was one procedure for losing weight.

Augustine et. al. (22) studied the nutritional adequacy, cost and acceptability of school lunches and saw a need for adjusting portion sizes according to age and grade. Altschul commented that "large portions given to young children may well result in a very high plate waste figure which would not in fact be an accurate picture of the situation vis a vis desirability, palatability of the meal, and consumption amounts."

Paige (23) reported an association between poor consumption of milk and lactose induced symptoms and malabsorption.

(2) The logistics of the foodservice connotes the way in which a lunch is served and the environment in which it is served. Various studies (24, 25, 26) have cited the following factors as being, to some extent, causes of plate waste: (a) a long time spent waiting in line for lunch and the short time left for eating, (b) an impersonal relationship between the students and the lunchroom staff and (c) a generally unpleasant atmosphere, i.e., noisiness, a dirty eating area, an unspecified eating area, or a strict seating arrangement.

(3) Personal and social factors included problems of class preferences and peer group pressures, the restrictions associated with the lunch period, and the denial of lunch as a social experience (26). Bettelheim (25) noted that "where there are different meals for different people,

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superior or inferior qualities are implied which result in a socially divisive situation." He stressed the potential influence a complex situation like this has on conveying emotional and value judgements.

In Part III of the review, Altschul addressed the subject of food waste as a form of behavior, susceptible to modification. He states in his hypothesis that plate waste, like all behavior, is inextricably linked with other conditions such as (1) the environment in which the meal is served, (2) the form in which the food is presented, (3) the grade/age and cultural context, i.e., familiarity and food customs, and (4) nutrition education with emphasis on food. According to this hypothesis a complex of interrelated conditions must be changed in order to effectuate a maximum impact on plate waste. It was suggested that research is needed which will identify the causes of the plate waste problem and which will assess methods of reducing the problem.

In his summary, Altschul wrote,

> "The literature on school lunch plate waste and indeed institutional plate waste of any sort, is on the whole sparse, anecdotal, journalistic, and not up to scientific standards. A general impression that waste is a problem is conveyed. The data are, however, inadequate to draw more than superficial conclusions or to suggest definite remedies. Everyone agrees that food waste is an important problem and is a special category of economic, nutritional, and social loss."

2. Food Consumption in Other Child Nutrition Programs--Studies Conducted by the United States Department of Agriculture

(a) Cincinnati Summer Food Service Demonstration Project--Food and Nutrition Service

In the summer of 1972, the U.S. Department of Agriculture in conjunction with the Cincinnati Recreation Commission and other agencies within the city (27) conducted a demonstration project in the Special Food Service Program for Children's summer operation in Cincinnati, Ohio. The study was conducted over 47 days at 50 sites; 16 sites served lunches and 34 sites served supplemental meals (snacks). Data were collected from each site three to four times during the test period. Approximately 420,680 lunches and supplemental meals (snacks) were served during the test period; nearly 30 percent of the children served in the 50 sites participated in the study. Questionnaires were used to collect data from the monitors, recreation leaders, and foodservice managers regarding meal service, recordkeeping, food acceptability and plate waste for each recreational center. A five face hedonic scale was used to record the children's opinions of the lunch or supplemental meal. Actual plate waste was subjectively observed and recorded by the monitors. Menu acceptability was determined by consumption using assigned ratings based on a hedonic scale and plate waste comments.

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New approaches in menu planning were tested and evaluated. Lunch menus were planned to meet a predetermined nutrient standard of one-third of the RDA for 10- to 12-year-old boys and girls in the lunch sites and the supplements were planned to meet one-sixth of the RDA for 10- to 12-year old boys and girls in the supplemental meal (snack) sites. The nutritive value of menus was calculated using the nutrient tally program utilized in the Computer-Assisted Nutrient Standard (CANS) study funded by the United States Department of Agriculture - Food and Nutrition Service.

Data showed that the lunch menus, as initially planned, were low in some nutrients. Therefore, a new formulated fortified cookie or baked product was added to each menu. The cookies were fortified to or above the nutrient level of a slice of bread; baked products were formulated grain-fruit products with the primary ingredient derived from a grain product. The cookie or grain-fruit product helped achieve the nutrient standard of one-third of the RDA for protein, calcium, phosphorus, iron, vitamins A and C, riboflavin, thiamin and niacin. Some menus were still low in food energy. The standard of one-sixth the RDA for the supplemental meal (snack) was almost impossible to meet because of the limited variety of foods available. Because of inadequate cooling facilities for milk, full-strength fruit juice was served in 37 of the 47 supplemental menus.

As served, all lunch menus provided 100 percent of the standard for all nutrients except food energy for which all menus provided 80 percent or more of the standard. Data from the menu acceptability evaluation showed that hot lunch entrees had highest ratings among the children. Next in popularity were cold luncheon meat sandwiches such as ham, ham and cheese, and ham salad. Some of these sandwiches were prepared and frozen by industry and were designed to provide one-third of the RDA (except for food energy) for 10- to 12-year-old boys and girls when combined with one-half pint of milk. Most fruits, fresh or canned, were well accepted. In general, vegetables and salads were most often rejected, therefore these foods accounted for the largest amount of plate waste. Milk, flavored and unflavored, was well accepted by the students in the lunch sites.

Overall evaluation indicated a relatively good acceptability of most food items offered. However, some problems existed such as practicality of some of the fortified cookies and frozen sandwiches, cost, quality, food safety, portion sizes and unfamiliar food, adequate staffing, adequate equipment, cooperation among the sites and the availability of trained personnel (at the State and Federal levels) to use the Computer-Assisted Nutrient Standard (CANS) approach to menu planning. The authors made recommendations for improving the summer food service program operations in the areas of equipment, adequately trained personnel, monitoring, delivery services, sites, food used and overall planning.

(b) The Special Milk Program--Food and Nutrition Service

In 1975, the Department's Child Nutrition Division (28) conducted an evaluation of the Special Milk Program (SMP). Two of the objectives were: (1) to identify the sources and amounts of milk consumed by school children and (2) to determine the extent of milk waste in schools and factors affecting the waste.

Data were collected on milk consumption in 768 elementary and secondary schools during March and April of 1975. The school administrator and the foodservice supervisor (where applicable) of each school completed a questionnaire on the food and milk service operations in the school. To measure the relative difference in students' total daily milk consumption, students recorded the number of cartons or glasses of milk they drank at school and away-from-school. Twenty thousand questionnaires were collected from students. Milk waste was measured in all schools participating in one or more Child Nutrition Programs. Milk cartons were collected from 20 to 40 students at the end of the lunch period in each school. The number of unopened and empty milk containers were counted and the unconsumed portion of partially empty containers was measured volumetrically.

A significant difference in student milk consumption was apparent between students in schools participating in the SMP and students in schools not participating in the program. Mean away-from-school consumption was almost identical in both types of schools, but students in schools with the milk program consumed almost 42 percent more milk at school than did students in schools without the program (1.02 versus 0.72 cartons or glasses.

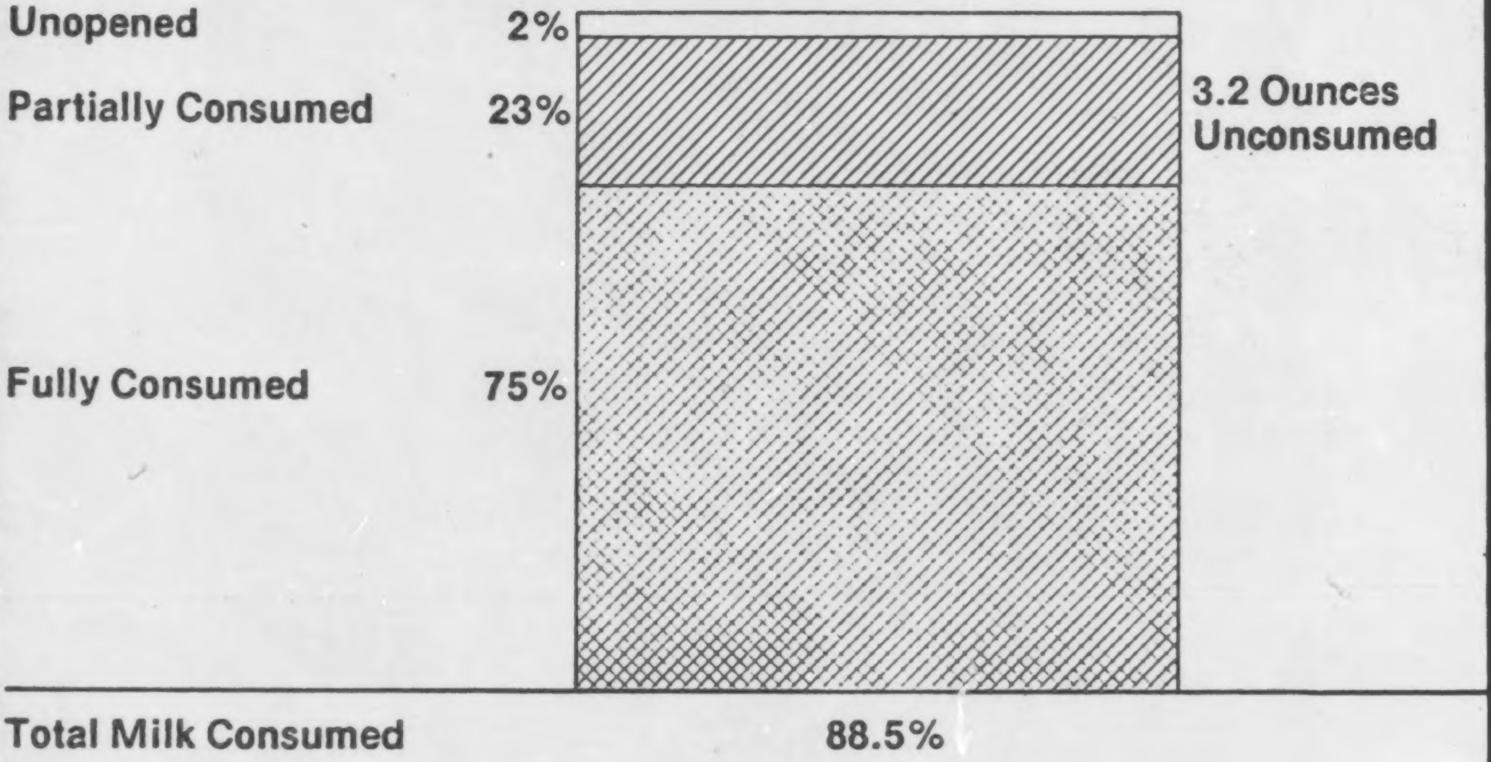
In schools with the milk program the higher consumption was attributed to the NSLP more so than to the SMP.

Almost 90 percent of the schools which participated in the Special Milk Program also participated in the NSLP. It was noted, however, that both programs effected an increase in the levels of milk consumed by the student. Students in schools without either program had the lowest at-school milk consumption--0.47 cartons or glasses.

According to student questionnaires, the distribution of total daily milk consumption by students of different ages represented a bell-shaped curve. The daily consumption rose through the early grades, peaked and reached a plateau in the middle grades and declined from the ninth through the twelfth grades. Because no standard measure of a carton or glass was provided, this information cannot be taken as an accurate reflection of students' absolute milk consumption.

Overall data on measured milk consumption showed that in schools participating in the SMP and the NSLP, milk consumption averaged 88.5 percent of the amount served (See Figure III-1). Milk consumption averaged 85.2 percent in elementary schools and 93.9 percent in secondary

FIGURE III-1 Milk consumption (in half-pints) in schools participating in the Special Milk Program and the National School Lunch Program



schools. Availability of flavored milk was a factor associated with increased milk consumption. In schools with flavored milk, students consumed about 16 percent more milk at school and 7 percent more milk on a 24-hour basis than did students in schools which did not make some flavored milk available. As can be seen in Figure III-2, milk consumption averaged 92 percent in schools offering flavored milk at lunch while milk consumption averaged 86 percent in schools offering unflavored milk only.

3. Food Consumption and Nutrition Evaluation--Studies Conducted by Other Institutions

(a) Major Nutrients in the Type A Lunch--North Carolina State University

Head et. al. calculated and chemically analyzed the nutrient content of Type A lunches served to (29) and consumed by (30) students in the central, eastern and western regions of North Carolina between 1970 and 1972. Data were collected on five randomly selected days from each of 22 schools in the Fall and again in the Spring of the school year. Participants in the study were 1,650 fifth, seventh and tenth grade students. The nutrient content of the lunches as served was determined from four lunch trays randomly selected from the serving line during the time that the test grades were served. The edible portions of two lunch samples were combined in one container, flushed with nitrogen and packed in dry ice for chemical analysis. The other two sample lunches were combined in the same manner.

Calculated levels were determined from recipes for all foods served, along with the number of servings from each recipe, which were obtained from the manager in each lunch room. Lunches were analyzed for protein, fat, ascorbic acid, thiamin, riboflavin, vitamin A, iron, calcium and food energy. Analyzed and calculated values were compared with a standard of one-third of the mean of the RDA (1968) for males and females in the age groups studied. For elementary schools, values for 1- to 12-year-old boys and girls were used and for secondary schools values for 14- to 18-year-old boys and girls were used.

Edible plate waste was collected from students' returned trays, flushed with nitrogen and stored in dry ice for delivering to the laboratory where it was analyzed for the nutrient content. The number of returned trays used to determine plate waste depended on the type of foodservice used in a given school. Nutrient intake was based on the difference between the nutrient content of the lunches served and the nutrient content of the plate waste.

Results of the laboratory analysis for nutrients from composites of Type A lunches, as served (29), showed that lunches were inadequate in food energy, and a high proportion were deficient in ascorbic acid and iron in the elementary schools; lunches were low in food energy and iron in the secondary schools. On the average, 43 percent of the

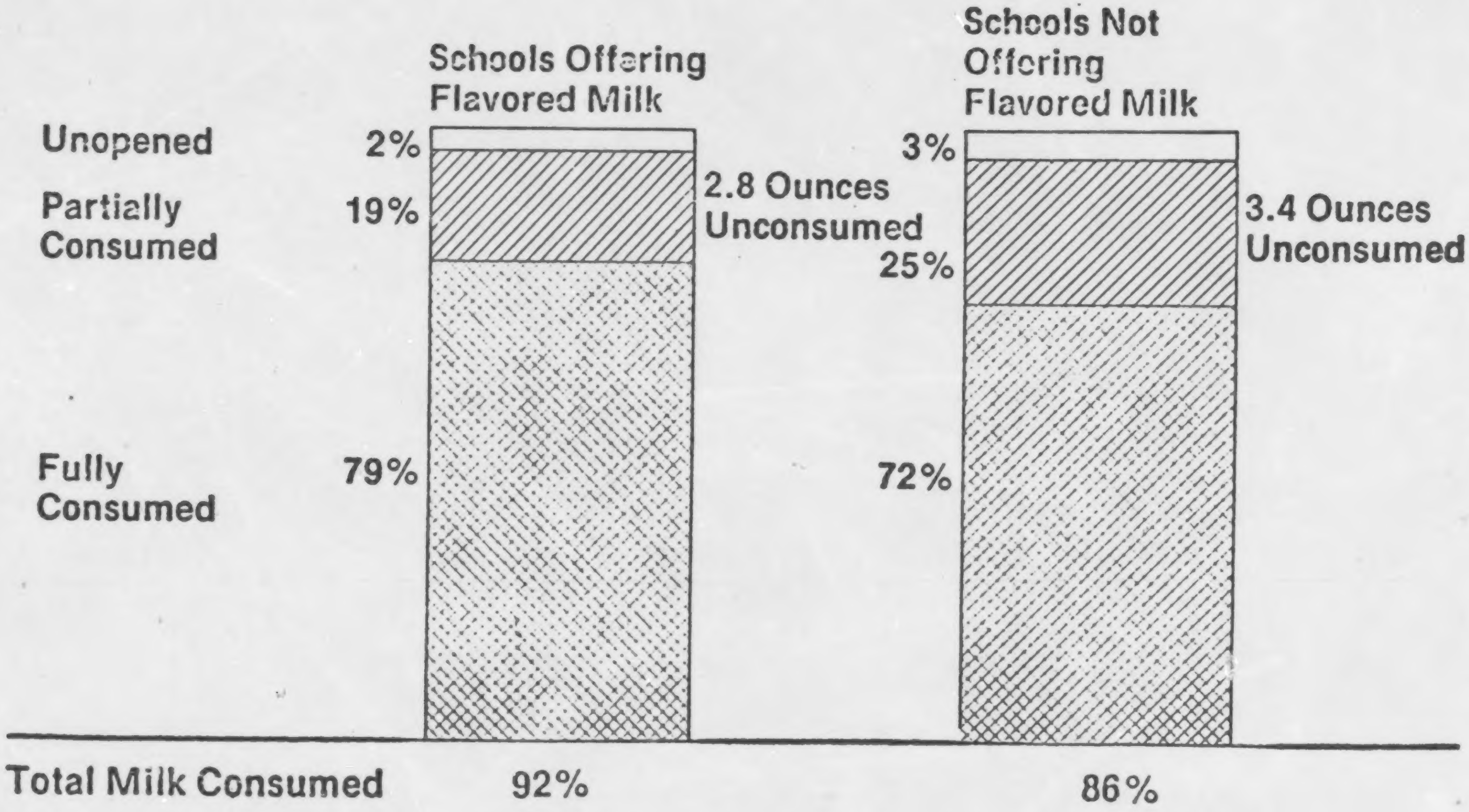


FIGURE III-2 Milk consumption (in half-pints) in schools offering flavored milk and schools not offering flavored milk

calories were contributed by fat; on 13 percent of the composites, over 50 percent of the calories were from fat. The analyzed levels for food energy never met the standard for the lunches as served; the calculated levels met the standard in only about two-thirds of the schools. The authors noted the differences between the analyzed values and the calculated values for the nutrients and attributed the differences to methods of data collection and food handling procedures.

Regional trends within the State were noted with foods containing certain nutrients as served. For instance, fat contributed 42 percent of the calories in the western region of the State, 39 percent in the Piedmont region and 46 percent in the eastern region. The high value in the eastern region was attributed to the amount of fat and rich sauces used for seasoning. In the eastern region, high levels of vitamin A and carotene were attributed to greens and sweet potatoes which were frequently served in the schools.

In a separate report (30), the consumption data (which were compared to lower nutrient standards than used for the data as served) showed that fifth grade students consumed a significantly lower percentage of the nutrients present in lunches than did seventh and tenth grade students. The authors noted that this was not caused by excessive serving portions. For all age groups protein levels in lunches as consumed exceeded the standard; riboflavin and vitamin A were at adequate levels. Food energy intake, relative to the standard, was inadequate. In 18 of the 44 collection sites, food energy intake was less than 70 percent of the standard. The percentage of calories from fat in all age groups was relatively high. For fifth grade students, intake levels of iron and calcium were adequate while in the other grades, intake levels of 69 percent of the standard for iron and 93 percent for calcium were achieved. (Standards used in the report on lunches as served (29) were not consistent with the standards used in the report in lunches as consumed (30).) Vitamin C foods were served and consumed in high amounts by high school students only; fifth and seventh grade students were served less and consumed less (22 of the 30 sites consumed less than 70 percent of the standard for ascorbic acid).

The nutrient intake showed significant regional differences within the State of North Carolina which were similar to nutrients as served. Total nutrient intake was shown to be higher in the eastern region. The greatest differences were in vitamin A and vitamin C. As stated earlier, sweet potatoes and greens were served frequently in the eastern region. In addition, higher proportions were eaten. This factor also contributed to the higher iron intake by students in the eastern region.

(b) Effect of a Flavored Milk Option in a School Lunch Program--The Pennsylvania State University

In recent years, flavored milk has been offered as an option in Type A lunches. Guthrie (31) studied the effects of this milk option on participation, nutrient intake and on plate and milk waste by students in a central Pennsylvania elementary school. Consumption data were collected from approximately 400 children in grades one through six.

Four familiar menus were randomly incorporated into the lunch program and on two experimental days, each menu was offered with an option of chocolate whole milk; on two control days, only unflavored whole milk was available. Data from experimental and control days were compared to assess the effect of the option of flavored milk. The nutrient content of the lunches as served was determined from five lunch trays randomly selected during each of two lunch periods on each test day. The average of the ten weights for each food item was used to calculate the nutrient content of the lunches, using data from composition tables. Returned trays were collected at the end of the lunch period and the amount of unconsumed food was determined from weight of the food plus the disposable serving materials returned. All milk containers used by the students participating in the Type A lunch program were collected. The number of unopened and empty cartons was recorded and the unconsumed portion of partially filled cartons was measured volumetrically; records for the two types of milk were kept separately. The data from the sample tray, the returned tray and the milk cartons, and plate and beverage waste were used to calculate the amount of food consumed. Plate waste on individual items was not weighed; thus, the authors assumed that food waste was consistent for all food items in any one menu and concluded that any errors introduced by this assumption were the same in both experimental and control groups. From the data on the food consumed, the nutrient content of the lunches as consumed was determined. The nutrient content of the lunches was compared to one-third of the RDA for 7- to 10-year old children and 11- to 14-year old children. Results were reported on students in grades one through five, grades one through six and grade six. Participation data were based on 3,700 students from ten elementary schools in the area.

Results showed that the nutrient content of the lunches as served varied considerably among the menus although all conformed to Type A lunch guidelines. For the 7- to 10-year old group, all lunches (with milk) achieved the standard for protein, calcium, riboflavin and vitamin C. Three of the four lunches achieved the standard for vitamin A. Only one lunch achieved the standard for iron or thiamin or food energy, regardless of the type of milk included. For the 11- to 14-year old group, calcium, vitamin A and food energy were most often deficient and the level of iron never achieved the standard. Ascorbic acid achieved the standard for males and females in three of the four meals. Protein and riboflavin levels always achieved the standard.

Intake levels for some nutrients were significantly affected when a milk option was available. Riboflavin intake increased for grades one through five and grades one through six; for grade six, calcium and thiamin increased. Relative to the standard, calcium intake for the sixth grade students was significantly increased to an adequate level only when an option was available; riboflavin was adequate with and without the option.

Iron intake decreased in all groups. The decrease was significant in grades one through five and grades one through six. The levels of intake for other nutrients were not significantly affected. The author attributed the differences to the high milk consumption and lower food consumption that occurred.

Data on food waste showed that when a milk option was available to children in grades one through five and one through six, the amount of milk unconsumed was about one-third of the amount unconsumed when unflavored milk only was available; concurrently the percentage of food waste increased by one-third. When no option was available, sixth grade children returned twice as much milk but consumed the same amount of food as when an option was available.

Milk acceptability was greatly increased when a milk option was available; all students consumed some of their milk and 83 percent of the students drank all of their milk. Without a milk option, six percent of the students did not drink any of their milk and only 57 percent of the students drank all of their milk. Two to 12 percent of the students chose unflavored milk when a milk option was available. An announcement of the availability of a milk option did not influence student participation in the total lunch program but significantly more children bought milk alone.

(c) The Impact of Novel Military Feeding Systems on Dining Hall Attendance, Plate Waste, Food Selection, and Nutrient Intake--Letterman Army Institute of Research

In recent years, the military has conducted several nutrition surveys at various military dining facilities for the purpose of evaluating the nutritional impact of proposed novel military feeding systems introduced as a means of increasing dining hall utilization. In addition, two other objectives of the surveys have been to provide recommendations to improve the nutritional health status of military personnel, and to evaluate the nutritional quality of rations served.

Schnakenberg(32) recently reported the results of a survey of three military feeding systems and their impact on dining hall attendance, plate waste, food selection and nutrient intake. The three systems evaluated included:

(1) Conventional Feeding System: The military procures the food, manages the dining hall and prepares the foods. Military personnel use meal passes to obtain meals and are referred to as RIK (rations-in-kind) status personnel.

(2) Civilian Catering System: A civilian contractor is responsible for food procurement and dining hall management. Civilian cooks prepare the food. (RIK or COMRAT status unspecified).

(3) Cash a la Carte System: The military procures the food, manages the dining hall and prepares the food. In this system, all food items are unit priced and all former RIKs are converted to a commuted ration (COMRAT) status; that is, they are given cash in lieu of a meal pass.

Data collected in the dining hall included kitchen waste, attendance patterns, types of food selected, plate waste and nutrient intake per meal and per individual. A combined daily diary and twice-weekly interview technique was developed to evaluate the average daily nutrient intakes of each individual and to monitor the food intake of each test individual for 14 to 17 consecutive days.

Table III-9 shows the effects of the novel military feeding systems on plate waste in the dining hall. The data include inedible waste and are the averages of breakfast, lunch and supper meals. A comparison of percent waste at the civilian catered dining hall with the conventional military dining hall indicates decreases in plate waste in meat, fish, and poultry; grain products; leafy, green and yellow vegetables, and legumes and nuts in the catered system. This decrease was attributed, in part, to the caterer serving smaller sized portions of these food types. Table III-9 also shows that there was at least a 40 percent reduction in plate waste of milk products; meat, fish and poultry; grain products; beverages; eggs and egg products; legumes and nuts; and tomatoes in the a la carte system as compared to the conventional system. The author concluded that "improvements in food preparation, increasing the variety of foods offered at any given meal, and requiring the patron to pay for each item and serving will markedly reduce plate waste and reduce food procurement costs."

The author also reported on results from a survey at the Naval Air Station in Alameda, California, in which samples of three population groups participated in a dietary interview. Data were collected on the daily nutrient intake, food type selected and consumed, and where the meals were consumed.

Data on dining hall utilization showed that the RIK group consumed 31.6 percent of their meals in the dining hall under the conventional system and consumed only 11.1 percent of their meals in the dining hall after receiving cash in lieu of a meal pass. When the average quantities of selected food types consumed per dining hall meal were computed, results showed that item pricing markedly reduced milk and milk product consumption and slightly increased non-alcoholic beverage consumption. Dessert consumption tended to increase while the consumption of citrus fruits and juices, entrees and miscellaneous food types such as vegetables, tomatoes, potatoes, soups, fruits other than citrus, legumes and nuts remained essentially unchanged.

Table III-10 shows the average nutrient intake per dining hall meal for the RIK in the conventional feeding system and former RIK's in the cash a la carte system. The cash a la carte system led to a reduction in

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Table III-9 Effect of novel military feeding systems on percent plate waste

FOOD TYPE	FT MYER, VA	LORING AFB, ME	
	Civilian Caterer	Military Conventional	Military Cash a la carte
	--------------------Percent	--------------------	--------------------
Milk & Milk Products	4	5	2*
Meat, Fish & Poultry	11	15	8*
Grain Products	11	15	6*
Beverages	6	8	3*
White Potatoes	12	10	8*
Eggs & Egg Products	4	6	3*
Desserts	18	11	13
Veg., Leafy Green & Yellow	18	26	19
Citrus Fruits & Juices	13	6	8
Fruits, Other	11	9	6
Legumes & Nuts	14	24	10*
Tomatoes	9	23	10*
Soups	15	15	10

*Plate waste reduced at least 40% with Cash a la Carte System

Source: Schnakenberg (32)

Table III-10 Effect of cash a la carte system on average nutrient intake per dining hall meal 1/

Nutrient	RIKs Conventional	Former RIKs Cash a la Carte
Energy (kcal)	1171	1007
Protein (gm)	53	46
% Calories from Fat	44	45
Calcium (mg)	690	428
Calcium:Phosphorus Ratio	1:1.3	1:1.3
Iron (mg)	7.5	6.3
Vitamin A (IU)	2845	2213
Thiamin (mg)	0.69	0.54
Riboflavin (mg)	1.37	0.92
Niacin (mg)	8.3	8.2
Vitamin C (mg)	31	28

1/ Naval Air Station, Alameda, CA

Source: Schnakenberg (32)

levels of energy and protein intake per meal. In both systems, the percentage of calories from fat exceeded the desired maximum of 40 percent of calories derived from fat sources. There was a decrease in calcium and riboflavin intake which is a reflection of the large decrease in milk and milk products consumption noted in the study. Iron, vitamin A and thiamin intakes also decreased. Niacin and vitamin C intakes remained relatively constant.

Table III-11 shows the effect of the cash a la carte feeding system on average total daily nutrient intake of the RIK test population, as well as the percentage of individuals within the population with nutrient intakes below the RDA. The combined effect of a decrease in dining hall utilization and decreased nutrient intake per dining hall meal had a negative effect on the total daily nutrient intakes of the former RIK group. There were significant decreases in average daily intakes of food energy and riboflavin. Furthermore, there was a decrease in the average daily intakes of protein, calcium and thiamin in the former RIK group. The data on the percentage of the population with intakes below the RDA, show that significantly greater percentages of the former RIK (46 percent) had riboflavin intakes below the RDA under the cash a la carte system than

Table III-11 Effect of cash a la carte system on total daily nutrient intake and percentages of populations below Recommended Dietary Allowances (RDA) 1/

		RIKs CONVENTIONAL		FORMER RIKs CASH A LA CARTE	
Nutrient	RDA 2/	Mean/Day	% of Population Below RDA	Mean/Day	% of Population Below RDA
Energy	3000 kcal	2945	63	2375*	83*
Protein	54 gm	106	6	94	5
% Calories from Fat	40%	38	43	41	51
Calcium	800 mg	1138	31	852	46
Calcium:Phosphorus Ratio	1:2	1:1.5	14	1:1.8	22
Iron	10 mg	15	11	14	10
Vitamin A	5000 IU	4540	69	4302	76
Thiamin	1.5 mg	1.34	71	1.15	85
Riboflavin	1.8 mg	2.57	17	1.94*	46*
Niacin	20 mg	21.0	54	20.1	51
Vitamin C	45 mg	62	29	59	44

1/ Naval Air Station, Alameda, CA

2/ National Research Council (1974, males 19-22 years weighing 67 kg.)

* Statistically significant differences.

Source: Schnakenberg (32)

under the conventional system (17 percent). Under the cash a la carte system, there was an increase in the percentage of intake below the RDA for energy, calcium, thiamin, and vitamin C. The authors noted that the mean nutrient intake was very misleading. While the mean intake of a specific nutrient may have been well above the RDA, a high percentage of individuals may have had intakes below the RDA. For instance, data in Table III-11, show that although the average calcium intake under the conventional system was 1138 mg/day, well above the RDA of 800 mg, yet 31 percent of the individuals had intakes below the RDA. Data also show that 44 percent of the population had vitamin C intakes below the RDA although mean intake of 59 mg/day is well above the RDA of 45 mg/day.

The author comments that with the money currently provided, personnel were not obtaining the same quantities of essential nutrients from non-dining hall sources as they were able to obtain from the military dining hall; furthermore, item pricing in the dining hall decreased the consumption of certain key food types, such as milk, and therefore, tended to accentuate rather than alleviate existing nutrition problems.

The author concludes that:

> "Reduction of plate waste within any feeding system is a desirable goal, but the nutritional impact upon the individuals served by the system must be carefully evaluated and the nutritional health of individuals must not be sacrificed for the sake of reducing plate waste and saving money."

(d) Nutritional Adequacy, Preference, Acceptability, and Food Production Aspects of Hot and Cold School Lunches--Martin

The Martin study (16) mentioned earlier, was conducted over a six-month period and involved 210 ninth grade students from one junior high school and 215 fourth, fifth and sixth grade students from two elementary schools. Questionnaires were used to survey food preferences as well as hot and cold menu preferences. Five sample trays were collected to determine the serving size. The edible portion of each menu item was weighed and the average weight of each menu item was computed. Returned trays were collected at the end of the lunch period and the unconsumed portion of individual items weighed. Consumption was calculated as the difference between the portion served and the portion unconsumed.

The nutritional values of the lunch as served and consumed were calculated using values given in standard reference materials for food energy, protein and six vitamins and minerals. The nutrient value was compared to one-third the RDA for children ages 12 to 14 in the junior high school and ages 10 to 12 in the elementary schools.

Table III-12 shows the percent waste in the two elementary schools and the junior high school. Plate waste ranged from 17 percent for hot lunches to 20 percent for cold lunches in the elementary schools and from 10 percent for hot lunches to 11 percent for cold lunches in the junior high school.

Table III-12 Comparison of waste of hot and cold lunches between elementary and junior high schools

	Elementary Schools		Junior High School	
Lunches	Hot	Cold	Hot	Cold
		% Waste		
Set No. 1	23.0	22.0	11.0	11.0
2	16.5	24.5	11.0	10.0
3	14.0	20.0	12.0	12.0
4	14.5	19.5	6.0	11.0
5	19.0	18.0	11.0	10.0
Average:	17.4	20.8*	10.2	10.8

*Significant at .05 level

Source - Martin (16)

The hot and cold lunches were planned to be nutritionally comparable. On the average, both hot and cold lunches as served exceeded one-third of the recommended dietary level for all nutrients except iron which was less than the standard in all menus except in the junior high school hot lunches. In the elementary schools, hot lunches provided significantly higher levels of protein, iron and food energy and cold lunches provided significantly higher levels of ascorbic acid. In the junior high school, hot lunches provided significantly more protein and iron than the cold lunches.

Nutrient consumption was above one-third of the RDA in almost all cases for hot and cold lunches. In both the elementary schools and junior high school, there was a significantly higher intake of protein, iron and food energy for hot lunches than for cold lunches.

The author concluded that while there are advantages to serving hot lunches such as better use of commodity foods, cold lunches can be recommended as an acceptable means of providing lunches which are nutritionally adequate. Furthermore, information from the food preference questionnaires given to the children indicated that the cold lunches were as satisfactory as the hot lunches.

B. Review of School Foodservice Experiences Concerning Food Consumption

Through a review of the literature and experiences gained in administering the NSLP, many factors have been found to affect the quantity of foods consumed by children participating in the NSLP. Some of these factors include the acceptability of foods in menus planned, quality of foods purchased and food preparation, methods of merchandising and serving foods, portion sizes, environment in which lunches are served and consumed, peer pressure, scheduling of the lunch periods, time allowed for eating, attitudes of teaching and administrative staffs, and knowledge of food and nutrition on the part of the students. Food consumption is an emotional issue as well as a physiological necessity. All physiological senses are involved in acceptance of food items; attractive lunches which utlize a variety of flavors, colors, shapes, and textures, and proper food preparation methods can increase food acceptance.

The goal of every school lunch program is to serve nutritionally adequate, attractive and moderately priced lunches which will be consumed. School lunches that meet these standards can be achieved through carefully planned menus and quality food preparation techniques. Planning menus which contain a variety of foods which will satisfy school lunch customers and meet program requirements is a challenge that requires a knowledge of what foods children will eat, how they prefer them to be prepared, how frequently they will eat them, and how these factors can be incorporated into menus that include all required components of the Type A lunch.

Personal preferences of students must be taken into consideration in planning menus. Washington State University (14) evaluated the school lunch and breakfast programs in the State of Washington in 1972-73, and found that the most sensitive issue to both parents and students was the menu. The authors noted the importance of knowing the general food preferences of children as well as preferences associated with specific variables such as ethnicity or geographic location. The authors suggested that children should be allowed a degree of choice in the selection of foods, at least in regards to certain ethnic foods and the fruit and vegetable categories. They concluded that foods which have only limited popularity should not be served without providing an alternate choice.

In recent years, students' groups have been successfully utilized in working with foodservice managers to facilitate cross communication and to plan menus which incorporate student preferences, thereby reducing waste. A few school districts which have found this approach helpful are discussed below.

- Monterey, California (33):

The district director of foodservice notes that ..."involvement is the key. Foodservice personnel, students, administrators, and parents must all work together and foster an atmosphere of cooperation. This will enable us to give the student what he or she needs, a nutritious but good tasting meal."

- Stone Mountain, Georgia (34):
At Rockbridge Elementary School in Stone Mountain, Georgia, a student "taste panel" has been organized to build interest in the lunch program and help eliminate plate waste. The students taste unusual foods or new recipes and discuss these foods in their classes and encourage their classmates to taste the food at lunch time.

- New Jersey (35):
Some schools have formed advisory committees that meet with cafeteria supervisors to discuss menu ideas and student preferences.

- Bismarck, North Dakota (36):
The foodservice manager at Bismarck High School often talks with the students soliciting their comments and criticisms. Students' suggestions are considered when planning the menus.

- Los Angeles, California (37):
Managers learn to adapt basic recipes to meet the needs of the students served and often student taste panels are formed to test new food items.

In addition to determining what foods are to be served, the menu planner must also determine the appropriate serving size of each menu item. To do this, the menu planner must know what amounts of foods are needed to meet lunch requirements for each age group, while being aware of the quantities of food young children are able to consume. Many successful foodservice directors prefer to serve small amounts of several foods to young children, rather than larger servings of a few foods. While the Department recommends that lesser amounts of foods be served to younger children participating in the NSLP (see Table II-1, page 4), these smaller servings have not been routinely implemented, resulting in additional plate waste. Revisions to program regulations have been proposed which are expected to require serving sizes appropriate to the age group served. These proposals will be discussed later in this report.

Once the menu has been planned, the quality of foods purchased and prepared has a direct effect on the consumption of foods on the menu. The service of high quality food is the foundation on which a successful lunch program must be built. Additionally, proper merchandising is influential in selling food and increasing consumption. Sometimes appetizing food may require an extra "something" such as a sprig of parsley or a colorful display for eye appeal in order to be purchased and eaten (38). However, successful merchandising depends on food that is properly prepared and appetizing.

The preparation, service and merchandising of quality food in any quantity foodservice operation is a complex task and requires considerable personnel training and continuing education. Some school systems are aware of the need for training and thus provide foodservice training as a standard procedure for their foodservice personnel. In the Los Angeles School District (37), foodservice staff members participate in a detailed 2-week training program which takes place in the classroom as well as on-the-job. The training is offered to cafeteria managers, pastry cooks, and salad cooks as well as to people on the eligibility list prior to employment There are also special courses in business reporting and cost accounting for manager trainees. Additionally, some employees take courses in nutrition and health services at community colleges.

During the 1972-1973 school years, USDA (39) conducted a study of high school participation in the NSLP in twenty high schools throughout the country and found a need for training school foodservice personnel. Ten schools studied had high participation (over 80 percent of the average daily attendance) and ten schools had low participation (less than 20 percent of the average daily attendance). Results showed that in all schools in the study, food quality ranged from poor to good with most falling the the average category. In most of the schools there was a need for training in the use of recipes and proper food production techniques. Data showed that in the high participation schools, a concerted effort was made to merchandise the lunch. The food was well displayed in the serving lines, attractively served and easily accessible to the students. In most of the low participation schools, this was not done. Evidence of the need for training was also seen in the Colorado State University study on delivery systems (13) which concluded that food consumption was related to food preparation techniques and the length of time between preparation and service. Both of these factors affected the appearance, taste, temperatures at time of service, and overall quality of the food served.

Many schools have reported increased participation and food acceptability when extra efforts were made to improve foodservice. These efforts may be in the areas of menu expansion, the manner in which lunch is served (i.e., family style), environment (i.e., decor of the cafeteria), scheduling the lunch period to allow sufficient time for eating the lunch and the relationship between the foodservice staff and the students. Such efforts require the cooperation of the principal, teachers, students and foodservice personnel. Student involvement is often the key which makes these efforts successful.

Bismarck High School (36) in Bismarck, North Dakota changed their school foodservice operations to include: (1) an expanded menu with five Type A lunch selections, a diet plate and a bag lunch, and (2) service of food with an attractive appearance. School lunch participation increased nearly 370 percent. When schools in the Souderton Area School District of Pennsylvania (40) offered more menu item choices, participation greatly increased. Students in elementary as well as secondary schools can now select a regular Type A lunch with an entree (and a choice of two vegetables) or they may select from two other menus which meet Type A lunch requirements - the "soup and sandwich" combination, or a hot dog and soup with choice of one vegetable. (All come with milk and dessert.) In 1976, daily participation averaged 93 percent in the elementary schools, 96 percent in the junior high schools and 77 percent in senior high schools. In Poughkeepsie, New York (41), a school lunch director has found that choices at the elementary and secondary levels provided the students with an opportunity to select foods they preferred and thus increased consumption. Within the district, the foodservice is geared toward the age and needs of the students and the geographic location of the school. In addition to the choice lunches, merchandising is a very important feature. The director credits the success of her programs to good management and training. In Kentucky (34) about 100 junior and senior high schools have adapted a "smorgasbord" system. A variation of this system is also used in some elementary schools. The school foodservice director has noted that this change has increased acceptability of the lunches and improved participation.

School foodservice personnel in Waterloo, Iowa (42), formed a club and found a way to reduce plate waste and get students to try new foods. The "Two Bite Club" was inaugurated at an elementary school serving children in kindergarten through the third grade. During a two week trial, students were encouraged to try at least two bites of everything on their lunch trays. Students who cooperated were given special pins. The staff observed that "unfamiliar foods were at least sampled by most students and students often urged each other to eat two bites; plate waste was noticeably reduced."

The Colorado study evaluating the food delivery systems (13) noted the importance of methods used to serve food to children. Students reacted negatively to methods with an assembly-line characteristic. The care taken by foodservice personnel in serving the lunch is very important. A pleasant, smiling face on the other side of the counter can do much to encourage a child to eat.

The USDA High School Participation Study (39) found that proper scheduling and the length of the lunch period were two important factors in participation. Lunch periods ranged from 23 to 40 minutes. When lunch periods were too short, many students didn't bother to eat or got a quick snack from the a la carte line. One principal indicated that there were less discipline problems with a longer lunch period.

The environment of the eating area must be conducive to the acceptance and enjoyment of the well-planned and properly-prepared lunch. This includes maintaining a low noise level in the eating area as well as keeping it clean and attractive. Cleanliness is a prerequisite for all areas involving preparation and service of food. Many schools which involved students in decorating their cafeterias and rearranging seating areas have found improved attitudes towards the lunch program. Increased food consumption is a natural progression from such efforts. The Philadelphia Home and School Council (43) conducted a survey in 1974 to find ways to provide a good lunch and minimize plate waste. The survey showed the need for cleaner food facilities, more discipline in the lunchroom and an improved eating environment; nutrition education was also lacking. When these problems were addressed and corrected, plate waste, although still a problem, was reduced. In Carrollton High School, (Carrollton, Georgia) "Project SMILE" (Suggested Methods for Improving Lunchroom Experiences) (44) was initiated to develop innovative approaches to traditional school lunchroom problems. Changes included: (1) an improvement in the decoration of the cafeteria, (2) food preference surveys, (3) "VIP" treatment for the senior students, and (4) menu choices for underclassmen. As a result of the project, the participation rate soared. In addition, a relaxed, warm atmosphere prevailed in the cafeteria and the students took pride in the lunch program.

School foodservice managers should encourage the support of the administrators, teachers, students and program coordinators to assist in developing an effective lunch program. Past program experience has shown that the attitude of the school administrator towards the lunch program has considerable impact on the attitudes of foodservice and teaching staffs. This in turn, is relayed to the students. In the High School Participation Study (39) results showed that positive attitudes of administrators, teachers, and foodservice personnel were seen in all schools with the high participation. In schools with low participation 50 percent of the administrators were indifferent to the NSLP, and only 20 percent had positive feelings about the program. In her commentary on school foodservice, Todhunter (45) expressed the need for the school feeding program to be a part of the total school program with the classroom teachers and foodservice personnel uniting their efforts to provide knowledge about nutrition.

Last, but not least, efforts should be made to develop an awareness of the importance of nutrition to health. Nutrition education activities should be directed toward: (a) the emphasis of foods needed for good health, (b) the development of good eating habits and their relationship to health, growth, and development, and (c) increased student awareness of plate waste. The nutrition education activities should occur in both the classroom and in the lunchroom. Hinton (46) discussed the development of good food habits in the cafeteria, the living laboratory for school lunch. In 1964, she wrote:

> "The lunchroom is a laboratory for nutrition education... No one can actually learn to taste foods unless he has a chance to eat them. If the school lunch is not providing such an experience it is not being used to its fullest potential. Teachers and school lunch supervisors have an opportunity to give guidance in learning to eat and enjoy a variety of foods..."

During the 1974-1975 school year, nutrition education was introduced, by the cafeteria manager into the classroom in Franklin Elementary School in Provo, Utah (47). The presentation took the form of an original fairy tale and focused on identifying good food and stressing the value of the school lunch program. Changeable bulletin boards with cartoon characters depicting sound nutritional information were used to complement the lesson. As a result of the nutrition education program, students were more willing to try unfamiliar foods and plate waste was greatly reduced.

C. Food and Nutrient Consumption in the National School Lunch Program, 1977--A Study Conducted by the U.S. Department of Agriculture

The preceding review of literature contains very little data on plate waste in the NSLP. To obtain additional data on the magnitude of the plate waste problem and its associated nutritional implications, the Department conducted a pilot study of food and nutrient consumption in the NSLP. The following is a report of the study in its entirety.

1. Objectives

The principle objectives of the study of Food and Nutrient Consumption in the NSLP were to: (1) assess the nutrient contribution of lunches as served to and consumed by students participating in the NSLP, (2) compare the nutrient contribution of lunches prepared and served in schools with on-site kitchens with lunches prepared in a central facility, preportioned and delivered to another school for service to children, (3) assess the acceptability of foods by school children, by determining the level of consumption of different types of foods served in each of the two types of foodservice systems, and (4) determine the amounts of food waste in schools in relation to kinds and amounts of foods served in the program.

These data were essential for evaluating the effectiveness of the program and assisting States and local school districts to more efficaciously provide nutritionally adequate lunches for students.

Other objectives of this study were to: (1) compare the nutrients in lunches served to and consumed by elementary students with secondary students, (2) compare the level of nutrients in lunches consumed by males with females, and (3) determine how the Type A Pattern was interpreted by school foodservice managers.

The study also included information on daily participation, prices charged to the students for lunches served in the two foodservice systems, and the amount of foodservice training among the menu planners.

2. Methodology

(a) Sample Selection

One of the major objectives of the study was to compare lunches prepared and served in on-site kitchens to those preportioned and delivered from a central kitchen or a non-school source. Elementary and secondary schools which served these different lunches were selected from the participants of a 1972 National School Lunch Program survey (48) conducted by FNS. All schools in the 1972 survey sample were classified according to grade levels, geographic locations and school size. Of the approximately 650 schools included in the 1972 study, fifty-two served preportioned-delivered lunches and were included in the sample. Fifty-two schools with on-site preparation were selected from the array of schools in the original sample survey listing. The 104 selected schools from 35 States and the District of Columbia were then screened to verify the continued use of the expected foodservice systems. When a replacement for schools serving preportioned-delivered lunches was necessary, replacements were randomly selected from the remaining list of schools (within the same USDA-FNS region), identified as serving lunches delivered to the school in bulk quantity in the 1972 National School Lunch Program survey. These schools were contacted to determine if they had changed from bulk to the preportioned-delivery system. If, after exhausting the list, a satisfactory replacement was not located, a Child Nutrition State Director within the same USDA-FNS region was contacted and asked to select a school having this type of foodservice system. Likewise schools with on-site preparation and service were replaced when necessary with additional selections from the original 1972 sample survey listing.

The final sample contained 80 elementary schools, 17 junior high schools, and 7 senior high schools. Fifth grade served as the test grade in the elementary schools, ninth grade in the junior high schools and tenth grade in the senior high schools. Because of the small sample size, data from the ninth and tenth grade students were grouped together as secondary students for the purpose of analyzing the data on plate waste and nutrient consumption.

(b) Training for Data Collectors

Prior to the initiation of the study, a detailed training session was conducted in each of the five established FNS regions for all regional staff members who were expected to collect the data for the study. At the beginning of the session, the objectives of the study were reiterated and key pointers were given on how to make initial contact with the participating States, scheduling each test school, determining average portion size and random sampling of returned trays including identification of selected food choices and sex of student. Staff members were given a data collector's manual which included a list of the equipment needed, a set of precoded forms and a detailed explanation of how to collect the data. The purpose of each form was explained. As a part of the training, a practice session was conducted in a local school.

(c) Data Collection

Data on the school's demography, sample tray serving sizes, recipes for all menu items served, and plate waste from students were collected from September 1975 to February 1976. Data were collected from each test school on two consecutive school days; all days of the week were represented. In each region, a team consisting of a Nutrition and Technical Services Staff member of FNS and a State School Lunch Program representative collected the data. It was emphasized that the team was not there to audit or review the lunch program in the school. After completion of the first test school in each region, forms were completed and sent to Washington to be reviewed for completeness and accuracy.

Demographic Data:

Information on the school's demography was obtained from the foodservice manager and principal's office on the first day in the test school. Demographic data included: (1) geographic location, (2) grades included in the school, (3) type of school - public or private, (4) type of campus - open or closed, (5) prices charged for full and reduced-price lunches, (6) site of lunch preparation, on site or off premises, (7) source of preportioned-delivered lunches--school system or non-school, (8) forms in which lunches were received, (9) average daily student attendance, and (10) average daily participation by students in the free, reduced-price and full-price categories. Actual student attendance and the number of lunches served in each price category were collected on each test day.

Menu Items and Recipes:

In on-site schools, the survey team arrived each test day in time to observe the preparation of each menu item included in that day's lunch. The teams recorded the menu item to be served, and every ingredient used to prepare each item. These data were used to calculate the nutrient contribution of each menu item as well as the contribution of each menu item toward the Type A Pattern.

A recipe sheet was completed for every menu item, including menu items consisting of only one ingredient, e.g., milk or canned fruits. Every food or ingredient used in the recipe was listed including water (unless drained off), seasoning, and butter brushed on top of the rolls. A detailed description of each food was recorded, e.g., canned, dehydrated, cooked, to be cooked, concentrated, diluted, drained or undrained, fortified, etc. All ingredients used in each recipe were weighed when practicable and the weight was recorded. Volumetric measures were used for liquids. Units were recorded for such items as eggs, and #10 cans of fruits and vegetables. If any menu item was prepared prior to the test day, the recipe was recorded as accurately as possible and the number of servings produced from the recipe was noted.

For schools receiving preportioned-delivered lunches from a base kitchen, a detailed description and the weights of all foods used to prepare the Type A lunch for the test school were obtained from the base kitchen at the time of preparation. When preportioned-delivered lunches were obtained from a non-school source, information on the weights of all ingredients used in all menu items for each test day, or a nutrient analysis for all foods on the menu, was obtained from that non-school source.

Sample Tray Data:

Weights were obtained for five random servings of each menu item to determine the average weight of a serving. In schools which offered only one Type A lunch, five complete sample trays were randomly collected as the test grade was served. In schools with choices for the Type A lunch five samples of every menu item which could be included as a part of the Type A lunch were randomly selected. The edible portion of all menu items was weighed with the use of dietetic gram scales.

This information was also used to calculate the nutritive values of the lunch and in subsequent analysis of data to determine the quantity of plate waste and how the Type A Pattern was interpreted by the foodservice staff.

Plate Waste Data:

To determine the amount of food consumed, trays were randomly selected at the end of the lunch period from 30 students in the test grade. A marker was placed on each girl's tray in order to later identify the return tray as being from a boy or girl. In schools allowing menu item selection within the Type A lunch, a numbered marker was placed on each student's tray and the selection of food on the tray was recorded on a plate waste data form with a corresponding number. These students were asked to return their tray to a designated area when finished.

After students had returned their trays, the edible unconsumed portion of each individual food on each tray was weighed and the weight recorded. This weight was subtracted from the average weight of a serving for the food, thus providing the weight of each food consumed by individual students.

(d) Data Analysis

Demographic data were used to compare the two foodservice systems (onsite versus preportioned-delivered) on the basis of school characteristics, average daily attendance, average daily participation, participation in the free, reduced-price, and full-price lunch categories for the two test days, and mean price of lunches in each category.

Data from the sample tray form were used to determine the average size as well as the consumption of menu items most frequently served. Numbers unique for each menu item were assigned which enabled analysis of each menu item served as a part of the Type A lunch on the two test days in each sample school. Menu items were further classified according to one of ten food categories: 1) meat, 2) raw vegetables, 3) cooked vegetables, 4) potatoes and pasta, 5) fruit, 6) desserts, except fruit, 7) bread, 8) milk, 9) combinations, and 10) miscellaneous. Combinations included foods such as spaghetti and meat sauce, hoagie sandwich, and macaroni and cheese dishes. Miscellaneous items included foods such as catsup, potato chips, salad dressings and butter. Consumption was measured for each of these ten categories.

One of the objectives of the study was to determine how the Type A Pattern was being interpreted in individual schools. To do this, the weight of each food which contributed toward one or more components of the Type A Pattern was calculated for its percent contribution towards each of those components. The percent contributions for all menu items for each component were added to determine the total percentage of Type A lunch requirements satisfied by each day's lunch. Volume - weight equivalents were used for the vegetables and fruits to determine their contribution toward the three-fourths cup requirement for the vegetable/fruit component in the Type A Pattern.

Guidelines for determining the credit given to each menu item for its contribution toward the Type A lunch requirements were based on information presented in the United States Department of Ariculture's publication A Menu Planning Guide for Type A School Lunches, Program Aid No. 719 (4). For example, no ingredient contributed toward more than one component; any one fruit or vegetable was given credit for no more than five-eighths cup; and fruit and vegetable juices were given maximum credit of one-fourth cup.

Nutrient contribution for each menu item served was calculated based on the amount of each ingredient in the menu item. The data were used to determine the nutrient contribution of each total lunch. The amount of food consumed was calculated as the difference between the quantities served and the quantities unconsumed. This information was used in calculating the level of nutrients consumed. Lunches were assessed for food energy, and the following indicator nutrients: protein, fat, iron, calcium, phosphorus, ascorbic acid, vitamin A, riboflavin, thiamin, and niacin. Agriculture Handbook No. 8 Composition of Foods, Raw, Processed, Prepared was the primary source of nutrient data (49). For some food items served in the preportioned-delivered lunches, the nutrient data were furnished by the source supplying the lunch. Information on food yields was obtained from Agriculture Handbook No. 102, Food Yields Summarized by Different Stages of Preparation (50). When appropriate, moisture losses in cooking were calculated.

3. Statistical Analysis

The analysis of variances to test differences between foodservice systems for each sex and each grade level as required by the design would be:

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Source	Degrees of Freedom
Total	$\Sigma n_{ijk} - 1$
Foodservice system	1
Schools within foodservice system	$\Sigma(s_{ij} - 1)$
Students within schools	$\Sigma(n_{ijk} - 1)$

where s_{ij} is the number of schools in each system and n_{ijk} is the number of students sampled in each school The F test for differences between schools is based on variability of students within schools and the F test for foodservice systems is based on variability between schools. If the number of schools per foodservice system is equal and the number of students per school is equal, the analysis is straightforward. Unequal numbers introduce a complication which depends on the pattern of unequality.

School mean, the average consumption of all students in each school, tends to be normally distributed. This suggests doing an analysis of variance of school means as the test for differences between foodservice systems. Differences between schools are of no great interest. The analysis of variance is of the form:

Source	Degrees of Freedom
Total	$\Sigma s_{ij} - 1$
Foodservice system	1
Schools within foodservice system	$\Sigma(s_{ij} - 1)$

The F test for foodservice systems is identical in the two analyses if the sample sizes are equal or proportional.

Analysis of variance of school means which are normally distributed would be a major gain in leading to correct probability assignments of the F tests. Therefore, statistical analysis of unweighted school means was conducted to detect and isolate differences between grade levels, sexes, and foodservice systems for the nutrients and for the menu items in terms of grams waste and percent consumed. To determine the effects of differences in serving sizes, an analysis of covariance was conducted on the menu items adjusted for serving sizes, on the assumption that larger serving sizes might lead to more waste or lower percent consumed. Specific comparisons were made for differences between foodservice systems within grade level for males, for females, and for sexes combined for the nutrients and for the menu items in terms of grams waste and percent consumed. A three-way analysis of variance was also conducted to test differences due to sex, grade level, foodservice system, and their interactions simultaneously.

Analysis of covariance is a facet of experimental design. The purpose of experimental design is to form homogeneous subsets of experimental material so that the effect of the item of interest can be measured validly, free of extraneous effects which can be controlled or eliminated. Discrete variables are used to form homogeneous strata so the effects can be removed by analysis of variance. The effects of continuous variables can be removed by regression. Analysis of covariance combines the analysis of variance and regression.

A variable of concern in this study is serving size. A small serving will be entirely consumed while excessive serving sizes will lead to increase in waste. The effect is eliminated when the serving size is constant as with the preportioned-delivery system or with milk. This is not the case with the on-site system and it is more realistic to measure and adjust for serving size than to force an artificial restriction to hold serving sizes constant. The analysis of covariance adjusts the variable of interest, waste, to a constant serving size by regression and uses deviations from regression, rather than deviations from the mean, as the basis of the test.

Simple Student's "t" tests were performed on each nutrient to determine the extent to which the RDA had been met for each sex and the average for elementary and secondary schools by each foodservice system.

To evaluate differences in waste and percent consumed which could perhaps be associated with the demographic characterization of the schools a simple analysis of variance was performed.

4. Results

(a) Demographics of Sample

Characteristics of Schools Sampled:

A total of 104 schools was included as part of the study to determine the effect of the type of foodservice system (prepared and consumed on site vs. preportioned-delivered) on plate waste and nutritional characteristics of lunches served and consumed. The characteristics of these schools are shown in Table III-13. Specifically, 80 elementary schools and 24 secondary schools were included. The fifth grade represented the elementary schools and the ninth and tenth grades represented the secondary schools. When a secondary school contained grades nine through twelve, the 10th grade was included in the sample. Two-thirds of the elementary schools contained grades K-5 or K-6. At the secondary level, over 40 percent of the schools contained grades 7-9 and one-fourth contained grades 9-12. As seen in Table III-13 many other grade options existed.

Regardless of grade level, most of the schools operated with closed campuses which means that students were not allowed to leave the school premises during the day without special permission. The data in Table III-13 shows that most of the schools sampled were public.

Table III-13 Distribution of size of schools by grade level and foodservice system

	Elementary		Secondary		
Enrollment	On-site	Delivered-Preportioned	On-site	Delivered-Preportioned	TOTAL
100-300	3	5	0	1	9
301-500	18	14	0	1	33
501-700	10	12	1	0	23
701-1000	5	7	4	5	21
1001-1400	2	3	5	1	11
1401-1700	1	0	2	2	5
1701-OVER	0	0	1	1	2
					104

There was a concerted effort to select schools which served lunches prepared on site that were comparable in size to schools that served preportioned and delivered lunches. Table III-14 shows the frequency distribution of the size of sample schools as determined by student enrollment. At the elementary school level, the number of schools in each range is comparable for both foodservice systems while at the secondary school level, the distribution appears to be less comparable. This is attributed in part to the small sample size that was available.

Price of Lunches:

The distribution of price for lunches and number of students served according to price categories are summarized in Table III-15. These data show that 46 percent of the lunches served in elementary schools were free while only 29 percent were free at the secondary level. At the elementary level, 50 percent of the lunches were at a full price, and 4 percent of the lunches served were at a reduced price while at the secondary level 69 percent of the lunches served were at a full price and 2 percent were at a reduced price. Overall, 55 percent of the lunches served were at a full price, 4 percent of the lunches served were at a reduced price and 41 percent of the lunches served were free. These data are comparable to National School Lunch Program statistics released for May 1977 by the Program Reporting Staff of USDA's Food and Nutrition Service. Their data on the National School Lunch Program show that 55.3 percent of the lunches served were at a full price, 4.9 percent of the lunches were at a reduced price and 39.8 percent were free.

It is interesting to note that the distribution of prices for full and reduced price lunches did not change appreciably between elementary and secondary schools included in this study. On the average, reduced-price lunches cost 16.3¢ (16.1¢ for elementary students and 16.9¢ for

Table III-14 Description of schools in the Food and Nutrient Consumption Study

School Type	Grades Included	Total Schools No.	Total Schools (%)	Public Schools On-Site No.	Public Schools On-Site (%)	Public Schools Preportioned-Delivered No.	Public Schools Preportioned-Delivered (%)	Private Schools On-site No.	Private Schools On-site (%)	Private Schools Preportioned-Delivered No.	Private Schools Preportioned-Delivered (%)	All Schools On-site No.	All Schools On-site (%)	All Schools Preportioned-Delivered No.	All Schools Preportioned-Delivered (%)
Elementary:		80	77	39	38	39	38	0	0	2	2	39	38	41	39
Open Campus:		14	13	7	7	7	7	0	0	0	0	7	7	7	7
Closed Campus:		66	63	32	31	32	31	0	0	2	2	32	31	34	33
Classes:	K-6	38	37	11	11	27	26	0	0	0	0	11	11	27	26
	K-8	6	6	1	1	4	4	0	0	1	1	1	1	5	5
	K-5	16	15	10	10	6	6	0	0	0	0	10	10	6	6
	4-8	1	1	1	1	0	0	0	0	0	0	1	1	0	0
	1-6	4	4	4	4	0	0	0	0	0	0	4	4	0	0
	1-8	2	2	1	1	0	0	0	0	1	1	1	1	1	1
	1-12	3	3	3	3	0	0	0	0	0	0	3	3	0	0
	5-9	1	1	1	1	0	0	0	0	0	0	1	1	0	0
	K-12	2	2	2	2	0	0	0	0	0	0	2	2	0	0
	4-6	3	3	2	2	1	1	0	0	0	0	2	2	1	1
	1-7	1	1	1	1	0	0	0	0	0	0	1	1	0	0
	1-5	2	2	2	2	0	0	0	0	0	0	2	2	0	0
	K-7	1	1	0	0	1	1	0	0	0	0	0	0	1	1
Secondary:															
(Jr. & Sr. High):		24	23	13	13	10	10	0	0	1	1	13	13	11	11
Open Campus:		2	2	2	2	0	0	0	0	0	0	2	2	0	0
Closed Campus:		22	21	11	11	10	10	0	0	1	1	11	11	11	11
Classes:	7-9	10	10	5	5	5	5	0	0	0	0	5	5	5	5
	9-12	6	6	4	4	1	1	0	0	1	1	4	4	2	2
	10-12	1	1	0	0	1	1	0	0	0	0	0	0	1	1
	7-8	2	2	1	1	1	1	0	0	0	0	1	1	1	1
	9	1	1	0	0	1	1	0	0	0	0	0	0	1	1
	K-4 8-12	1	1	1	1	0	0	0	0	0	0	1	1	0	0
	7-12	1	1	1	1	0	0	0	0	0	0	1	1	0	0
	6-8	1	1	0	0	1	1	0	0	0	0	0	0	1	1
	7-10	1	1	1	1	0	0	0	0	0	0	1	1	0	0

Table III-15 Distribution of price charged to students for Type A lunches

Price Category		Lunch Price (Cents)	Elementary				Secondary				All			
			School		Participation		School		Participation		School		Participation	
			No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Free			80	100	24936	46	24	100	6767	29	104	100	31703	41
Reduced Price	Total		70[1]	88	2377	4	21[1]	88	580	2	91[1]	87	2957	4
		05-10	22	28	1289	2	4	17	210	1	26	25	1499	2
		11-15	11	14	365	1	5	21	58	0	16	15	423	1
		16-20	37	46	723	1	12	50	312	1	49	47	1035	1
Av. price/reduced price lunch					16.1¢				16.9¢				16.3¢	
Full Price	Total		80	100	26848	50	24	100	16287	69	104	100	43132	55
		< 31	2	3	341	1	0	0	0	0	2	2	341	0
		31-40	26	32	10418	19	5	21	3888	16	31	30	14306	18
		41-50	36	45	10628	20	13	54	9116	39	49	47	19744	26
		51-60	16	20	5458	10	5	21	2544	11	21	20	8002	10
		< 60	0	0	0	0	1	4	739	3	1	1	739	1
Av. price/full price lunch					46.0¢				48.8¢				46.6¢	

[1] Several schools did not have students to qualify for reduced-price lunches thus, data are based only on the number of schools that offered reduced-priced lunches. However, percentages are based on the total number of schools in each grade level.

secondary students) and full-price lunches cost 47¢ (46.0¢ for elementary students and 48.8¢ for secondary students). United States Department of Agriculture - Food and Nutrition Service - Child Nutrition Division reports that for the 1976 school year, the average cost to students for reduced-price lunches was a little less than 20¢; the full-price lunches were 53¢.

Attendance and Participation:

Table III-16 shows student participation and average price in the three lunch price categories for both foodservice systems. In the elementary schools, participation in the lunch price categories differed according to the foodservice system. Schools serving preportioned-delivered lunches, had the highest participation in the free lunch category. In on-site schools, participation was highest in the full-price category. For secondary schools there were no real differences in the participation between foodservice systems; in both foodservice systems the majority of the students participating in the lunch programs paid the full price for the lunch. There was a small proportion of lunches served to students at a reduced price (5 percent or less) in both foodservice systems and at all grade levels. The data in Table III-16 also show that the full price for lunches served to students in schools with preportioned delivery was only slightly higher than those served in on-site schools - 47.1 vs. 44.7 respectively for elementary schools and 49.5 vs. 48.1 respectively for secondary schools.

The average daily attendance (ADA) and average daily participation (ADP) statistics are shown in Table III-17 for the elementary and secondary schools. The few private schools sampled (3) had preportioned delivery so it was impossible to look at the effect of foodservice system on ADA and ADP as a function of private versus public schools. In the public schools sampled, the ADP for lunches prepared on site was higher than for preportioned-delivered lunches at both the elementary and secondary levels.

The effect of grade level and foodservice system on percent participation was determined by analysis of variance. Results in Table III-17 show that percent participation was higher for elementary schools (65 percent) than secondary schools (50 percent). The difference was significant ($P<0.007$). The ADA for on-site prepared lunches was higher than for preportioned-delivered lunches at both the elementary and secondary levels. Considering all schools, on-site schools had higher percentage participation (65 percent) than schools serving preportioned-delivered lunches (54 percent). The difference was significant at $P<0.001$. Overall percent participation in this study was 60 percent which corresponds very closely with the national estimate of 58 percent reported by the Child Nutrition Division for March 1977. The effect of the full price of lunches on percent of ADP was determined by correlation analysis. The results showed that the percentage of free lunches served had little influence on the percent ADP.

Table III-16 Student participation in lunch price categories and average price of lunch by grade level and foodservice system

Price Category	Elementary				Secondary				All [1]			
	On-site		Preportioned-Delivered		On-site		Preportioned-Delivered		On-site		Preportioned-Delivered	
	Partici-pation (%)	Price (cents)	Partici-pation (%)	Price (cents)	Partici-pation (%)	Price (cents)	Partici-pation (%)	Price (cents)	Partici-pation (%)	Price (cents)	Partici-pation (%)	Price (cent
Free lunch	29	-	66	-	26	-	32	-	28	-	57	-
Reduced Price	4	16.0	5	16.1	2	19.0	3	15.0	3	16.7	4	15.9
Full Price	67	44.7	30	47.1	71	48.1	65	49.5	69	45.6	39	47.6

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[1] Totals for all students are weighted averages

Table III-17 Student participation and attendance in public and private, elementary and secondary schools, open and closed campuses

Grade Levels	Item	Schools		ADA 1/	ADP 2/	
		No.	(%)	No.	No.	(%)
Elementary	Total	80	100	42213	27558	65
	Total Private	2	3	486	266	55
	On-Site	0	0	0	0	0
	Preportioned-Delivered	2	3	486	266	55
	Total Public	78	98	41727	27292	65
	On-Site	39	49	20550	14531	71
	Preportioned-Delivered	39	49	21177	12761	60
Secondary	Total	24	100	24315	12054	50
	Total Private	1	4	460	80	17
	On-Site	0	0	0	0	0
	Preportioned-Delivered	1	4	460	80	17
	Total Public	23	96	23855	11974	50
	On-Site	13	54	13620	7590	56
	Preportioned-Delivered	10	42	10235	4384	43
All	Total	104	100	66528	39612	60
	On-Site	52	50	34170	22121	65
	Preportioned-Delivered	52	50	32358	17491	54

1/ See Glossary

2/ Percent participation = $\frac{\text{Average Daily Participation}}{\text{Average Daily Attendance}}$

Characteristics of Preportioned-Delivered Lunches:

The preportioned-delivered lunches served in the schools were supplied by a central kitchen within the school system (school only) or a non-school source (commercial) or a combination of the two sources. (See Table III-18.) Thirty-six of the schools (69 percent) received lunches from a school source only. Of these schools, 72 percent received lunches in the chilled form, 11 percent were delivered hot and 14 percent were in two forms, i.e., preportioned so that the hot lunches were delivered hot and the cold portions chilled. Three percent of the lunches were delivered as bagged lunches. Ten of the schools (19 percent) received lunches from a non-school source only and twelve percent of the lunches came from a combination of central preparation facility within the school system and non-school source. Of the lunches coming from a non-school source, thirty percent were delivered to the school frozen for heating prior to serving. Chilled lunches comprised 60 percent of the sample and 10 percent of the schools received two forms. Of those lunches coming from combination sources, chilled portions were received from a central preparation facility and frozen (to be heated) portions from a non-school source. The design of this study was limited to an evaluation of lunches prepared on site and lunches preportioned and delivered. Therefore, all forms of preportioned-delivered lunches (hot, frozen or chilled) were grouped together for the analyses of data.

(b) Food Consumption

Food consumption was evaluated in this study using two statistical variables - foods not consumed (plate waste) and the percent consumption by the student. To determine the effect of grade level (elementary vs. secondary), sex, and foodservice system (on-site vs. preportioned-delivery) on these variables, a three-way analysis of variance was performed on the school means. The results of the three-way analysis of variance on plate waste are given in Table III-19 and for percent consumption in Table III-20. It should be noted that combination items included such foods as spaghetti and meat sauce, sandwiches, pizza, etc. Miscellaneous foods included items such as butter, catsup, mustard, etc.

Grade Level Effect:

The tables show that the pattern of significant variables was approximately the same when the data were analyzed as plate waste or percent consumption. Secondary students consumed more food (77.3 percent) than elementary students (75.3 percent). Jansen et al (51) noted similar trends for acceptability (consumption) of foods. They found that secondary students consumed 82 percent and elementary students 76 percent. North Carolina State University (52) studied the Type A lunch and reported an overall food consumption of 83 percent for secondary students and 79.5 percent for elementary students.

Table III-18 Form of lunches received in schools serving preportioned-delivered lunches

Campus Type	Item	Site of Preparation	No. of Schools		Form Received						
					Bulk	Bagged	Other	Frozen	Chilled	Hot	Two Forms
			No.	%	Percent						
All	Public	School Only	33	63	0	3	0	0	70	12	15
		Commercial Only	10	19	0	0	0	30	60	0	10
		Combination 1/	6	12	0	0	0	0	0	0	100
	Private	School Only	3	6	0	0	0	0	100	0	0
		Commercial Only	0	0	0	0	0	0	0	0	0
		Combination	0	0	0	0	0	0	0	0	0
	Total	School Only	36	69	0	3	0	0	72	11	14
		Commercial Only	10	19	0	0	0	30	60	0	10
		Combination	6	12	0	0	0	0	0	0	100

1/ The six schools using a combination of sources received frozen portions from a commercial source and chilled portions from a central preparation facility within the school system.

Table III-19 Plate waste in food categories by grade level, foodservice system and sex

A. Probability of differences in plate waste by factor, or interaction between factors (Analysis of Variance)

Food Category	Grade Level	Foodservice System	Sex	LxD	LxS	DxS	LxDxS
1. Meat	-	-	.01	-	-	-	-
2. Raw veg.	.001	-	-	.02	-	-	-
3. Cooked veg.	-	.001	-	-	-	-	-
4. Potatoes/Pasta	.04	.01	-	-	-	-	-
5. Fruit	.001	.001	.06	-	-	-	-
6. Dessert	.02	-	-	-	-	-	-
7. Bread	-	.01	.001	-	-	-	-
8. Milk	.001	-	.02	-	-	-	-
9. Comb. Items	-	-	.01	-	-	-	-
10. Misc.	-	-	-	.04	-	-	-

L = Grade Level
D = Foodservice System
S = Sex

B. Plate waste in food categories by factor

	Grade Level		Foodservice System		Sex		
Food Category	Elementary	Secondary	On-site	Preportioned-Delivered	Male	Female	Total
	grams						
1. Meat	10.3	9.5	9.7	11.4	7.6	12.8	9.9
2. Raw veg.	15.7	27.2	22.0	20.7	17.1	20.5	18.7
3. Cooked veg.	31.2	34.9	27.1	37.5	29.6	34.3	31.7
4. Potatoes/Pasta	23.4	14.6	22.0	26.3	19.7	23.3	21.2
5. Fruit	13.3	28.8	13.6	20.3	15.3	18.9	17.0
6. Dessert	12.3	5.2	9.1	12.5	9.4	12.2	10.3
7. Bread	6.5	6.5	5.5	7.6	5.1	8.0	6.9
8. Milk	35.3	18.3	31.0	31.7	27.1	36.1	30.9
9. Comb. items	23.8	22.3	24.9	21.9	19.7	27.5	23.2
10. Misc.	2.7	2.6	2.3	2.9	2.3	3.0	2.6

Table III-20 Percent Consumption in food categories by grade level, foodservice system and sex

A. Probability of differences in percent consumption by factor or interaction between factors - (Analysis of Variance)

Food Category	Grade Level	Foodservice System	Sex	LxD	LxS	DxS	LxDxS
1. Meat	0.05	-	.001	-	-	-	-
2. Raw veg.	-	.001	-	.001	-	-	-
3. Cooked veg.	-	.001	-	-	-	-	-
4. Potatoes/Pasta	.01	.001	-	-	-	-	-
5. Fruit	.001	.001	.04	-	-	-	-
6. Dessert	.001	-	.001	-	-	-	-
7. Bread	-	.001	.001	-	-	-	-
8. Milk	-	-	.02	-	-	-	-
9. Comb. Items	.001	-	.01	-	-	-	-
10. Misc.	-	.001	-	-	-	-	-

L = Grade Level
D = Foodservice System
S = Sex

B. Overall means, percent consumption, by factor

Grade Level		Foodservice System		Sex		
Elementary	Secondary	On-site	Preportioned-Delivered	Male	Female	Total
75.3	77.3	78.6	72.8	78.3	73.0	76.0

C. Percent consumption in food categories by Factor

Food Category	Grade Level		Foodservice System		Sex		
	Elementary	Secondary	On-site	Preportioned-Delivered	Male	Female	Total
1. Meat	84.3	88.2	85.9	84.4	88.9	81.1	85.5
2. Raw veg.	52.8	50.1	57.1	43.7	55.2	45.7	52.2
3. Cooked veg.	50.7	50.3	56.8	43.1	53.7	47.2	50.8
4. Potatoes/Pasta	72.9	83.7	82.7	68.5	77.0	73.3	75.5
5. Fruit	79.5	67.7	80.9	72.7	79.0	74.2	76.9
6. Dessert	85.7	88.7	86.8	85.6	87.4	83.7	85.2
7. Bread	82.7	84.0	87.2	78.3	86.2	79.5	83.1
8. Milk	85.8	93.2	87.6	87.4	89.2	85.7	87.7
9. Comb. Items	82.5	85.6	84.1	82.1	85.6	80.6	83.6
10. Misc.	74.3	73.1	85.3	68.2	77.3	72.4	75.3

The grade level had an overall effect on plate waste and percent consumed and a significant effect on the grams of raw vegetables, potatoes/pasta, fruit, dessert and milk not consumed. In the case of raw and cooked vegetables and fruit, the secondary students wasted more than the elementary students. However, the percent consumption for both grade levels was about the same (slightly more than 50 percent) indicating that much larger portions of vegetables served to secondary students were contributory to the larger amount of plate waste. Fruit, however, appeared to be consumed at a lower rate by secondary students than elementary students (67.7 percent vs 81.6 percent). Results of the study conducted by North Carolina State University (52) showed that vegetables (except potatoes) had the lowest consumption rates. Elementary students consumed 55 percent of their vegetables; secondary students consumed 59.6 percent. Fruit consumption was also low; students consumed 60-70 percent of their fruits. The Harper and Jansen study (13) showed that secondary students consumed more of all categories of food at a higher level, a finding which was reversed for raw vegetables and fruit noted in the present study.

Milk was the most acceptable menu item category in the school lunches tested in terms of percent consumption (Table III-20). Secondary students consumed a significantly higher percent of their milk than elementary students (93.2 vs 85.8). The North Carolina Study (52) also showed that milk was the most acceptable menu item. Elementary students consumed 93 percent of their milk and secondary students consumed 95 percent of their milk. Studies that analyzed school lunches utilizing the Computer Assisted Nutrient Standard (CANS) method of menu planning reported similar results. (9, 11)

Foodservice System Effect:

The effect of foodservice system is also shown in Tables III-19 and III-20. Foodservice systems had a significant effect on plate waste and percent consumption of cooked vegetables, potatoes/pasta, fruit, and bread. A significant effect on the percent consumption of raw vegetables was also observed. In all these cases where significant differences existed, the on-site foodservice system had less plate waste and a greater percent of food served was consumed than was observed in the preportioned-delivery system.

The effect of foodservice system on percent consumption is shown in Table III-20. This table shows a higher percent consumption for on-site lunches than for preportioned-delivered lunches in all food categories with an overall average consumption of 78.6 percent and 72.8 percent respectively. Some of the greatest differences were observed for raw vegetables (57.1 percent vs. 43.7 percent), cooked vegetables (56.8 percent vs. 43.1 percent), potatoes/pasta (82.7 percent vs. 68.5 percent), and fruit (80.9 percent vs. 72.7 percent).

In the study of food delivery systems, Harper and Jansen (13) found that on-site lunches had an average consumption of 81 percent which was significantly higher than preportioned-delivered lunches which had a corresponding value of 65 percent. Although the differences in percent consumption between the two foodservice systems were larger in the Harper and Jansen study, it is clear in both studies that students have better consumption patterns with lunches prepared and served on site compared to those lunches prepared and preportioned at a site other than the serving school where they were reconstituted, heated, or otherwise prepared for service. In their study, chilled and frozen preportioned-delivered lunches were studied separately and the data showed that frozen or chilled lunches had lower acceptability than on-site lunches.

The interaction of grade level with the foodservice system was significant for raw vegetables for both plate waste and percent consumption and for miscellaneous items for plate waste. It is difficult to interpret the meaning of this difference.

Many factors associated with the foodservice system can affect the acceptability of individual menu items. For example, long holding times and individual servings tend to expose the preportioned lunch items to conditions where they can become dehydrated and approach room temperature. Both of these conditions are certainly detrimental to raw and cooked vegetables, potatoes/pasta, fruit and bread, and therefore could be the major causes for the acceptability differences that were measured. Perhaps these conditions are more controllable for foods prepared on site.

Harper and Jansen (13) reported that other factors such as the impersonality of preportioned-delivered lunches, inability to achieve optimum reheating conditions on all menu items on a single tray, larger portions and fewer menu items typically served on preportioned-delivered trays can also contribute to the significantly greater plate waste and lower consumption for the preportioned-delivered foodservice systems sampled.

Sex Effect:

The analysis of variance showed that male students ate significantly more of the meat, fruit, bread, milk and combination items than female students. The major differences for males vs. females were meat (88.9 percent vs. 81.2 percent), fruit (79.0 percent vs. 74.2 percent), bread (86.2 percent vs. 79.5 percent), milk (89.2 percent vs. 85.7 percent) and combination items (85.6 percent vs. 80.6 percent). Since the interaction of sex with grade level and foodservice system was not significant, the differences in body size, level of activity and other items associated with sex differences could account for the differences detected.

It is difficult to understand why only certain foods showed consumption differences according to sex and others did not. Perhaps food preferences, or the fact that certain menu items may be associated with weight control regimes or other personal attitudes may have an influence on the differences in percent consumption according to sex.

Table III-20 shows that male students consume a greater quantity of food than female students. The overall food consumption was 78.3 percent for males and 73 percent for females. The implications of these sex differences will be discussed in the section of this report which considers the nutritional content of the lunches served and consumed in the two foodservice systems.

The basic sampling design was not structured to determine if the portion sizes of the food items received by the participating students varied with sex; however, portion size could be an influencing factor.

Portion Size Effect:

The Type A Pattern recommends that larger portions of meat or meat alternate (3 oz vs. 2 oz) and fruits and vegetables (1 to 1-1/2 cups vs. 3/4 cup) be served at secondary seondary levels as compared to the elementary levels. Not all secondary schools follow these recommendations. Schools in this study served the portion size which was set as part of school policy. Because serving sizes can affect plate waste, an analysis of covariance was performed on grams of food not consumed and percent food consumed, corresponding to the three-way analysis of variance shown in Table III-19 and III-20 and discussed in the previous sections. The data for plate waste and percent consumption were adjusted for serving size to better account for the differences in serving size encountered in the schools sampled in this study. It was anticipated that an analysis of covariance would reduce the significance of grade level and potentially increase the effect of foodservice system and sex on plate waste and percent consumed. The results of the analysis of covariance are shown in Tables III-21 and III-22.

The results of the analysis of covariance on plate waste in Table III-21 clearly show that the serving size of all food items except milk and miscellaneous foods influenced the quantity of plate waste. This should be an expected result since serving sizes larger than the minimum requirements would typically lead to more waste.

Comparing the pattern of significance on Table III-21 with that on Table III-19 shows that the analysis of covariance led to reducing the effect of grade level on plate waste and increasing the effect of foodservice system and sex. Specifically, raw vegetables and dessert items no longer were significantly affected by grade levels as they were before the quantity of waste was adjusted for serving size. These same two items now show a significant effect for the foodservice system. In addition, for raw vegetables plate waste differed for male and female students.

Table III-21 Plate waste in food categories (adjusted for serving size) by grade level, foodservice system and sex

A. Probability of differences of plate waste by factor or interaction between factors. (Analysis of covariance)

Food Category	Grams Served	Grade Level	Foodservice System	Sex	LxD	LxS	DxS	LxDxS
1. Meat	.001	.04	-	.003	-	-	-	-
2. Raw veg.	.001	-	.001	.03	-	-	-	-
3. Cooked veg.	.001	-	.001	.04	-	-	-	-
4. Potatoes/Pasta	.001	.01	.001	-	-	-	-	-
5. Fruit	.001	.001	.001	-	-	-	-	-
6. Dessert	.001	-	.001	-	-	-	-	-
7. Bread	.001	-	.001	.001	-	-	-	-
8. Milk	-	.001	-	.02	-	-	-	-
9. Comb. Items	.001	-	-	.01	-	-	-	-
10. Misc.	-	-	-	-	.05	-	-	-

L = Grade Level
D = Foodservice system
S = Sex

B. Adjusted Plate waste in food categories by factor

Food Category	Grade Level		Food Service System		Sex	
	Elementary	Secondary	On-Site	Preportioned-Delivered	Male	Female
	grams					
1. Meat	11.3	6.8	10.6	9.9	7.7	12.9
2. Raw veg.	18.8	18.8	16.9	22.0	17.1	20.5
3. Cooked veg.	31.9	32.3	28.1	36.5	29.6	34.3
4. Potatoes/Pasta	23.8	13.6	14.1	28.2	19.7	23.3
5. Fruit	15.3	27.1	14.8	21.3	16.4	20.0
6. Dessert	11.5	8.2	8.0	13.7	9.4	12.2
7. Bread	6.7	6.0	5.2	8.1	5.1	8.0
8. Milk	35.5	18.6	31.5	31.7	27.1	36.1
9. Comb. Items	24.9	19.5	22.7	24.7	19.7	23.6
10. Misc.	2.7	2.7	2.4	2.9	2.3	3.0

Table III-22 Percent consumption in food categories (adjusted for serving size) by grade level, foodservice system and sex

A. Probability of differences in percent consumption by factor or interaction between factors (Analysis of Covariance)

Food Category	Grams Served	Grade Level	Foodservice System	Sex	LxD	LxS	DxS	LxDxS
1. Meat	-	.04	-	.001	-	-	-	-
2. Raw veg.	.001	-	.001	.06	.003	-	-	-
3. Cooked veg.	-	-	.001	-	-	-	-	-
4. Potatoes/Pasta	.004	.01	.001	-	-	-	-	-
5. Fruit	-	.001	.001	.04	-	-	-	-
6. Dessert	.001	-	.01	.02	-	-	-	-
7. Bread	.02	-	.001	.001	-	-	-	-
8. Milk	.02	.001	-	.02	-	-	-	-
9. Comb. Items	-	-	-	.01	-	-	-	-
10. Misc.	.001	-	.001	-	-	-	-	-

L = Grade Level
D = Foodservice System
S = Sex

B. Percent consumption in food categories by factor

Food Category	Grade Level		Foodservice System		Sex	
	Elementary	Secondary	On-site	Preportioned-Delivered	Male	Female
1. Meat	84	89	85	85	89	81
2. Raw veg.	51	55	58	43	55	49
3. Cooked veg.	50	49	56	43	53	47
4. Potatoes/Pasta	72	85	74	67	77	73
5. Fruit	80	67	81	73	79	74
6. Dessert	85	86	88	82	87	83
7. Bread	83	83	87	79	86	80
8. Milk	85	92	87	87	89	85
9. Comb. Items	82	85	84	82	85	81
10. Misc.	74	77	84	79	77	73

In the meat category grade level influenced the plate waste when quantity of waste was adjusted for serving size. Three ounces of meat, as recommended, is more typically served in the secondary schools than larger recommended servings of vegetables or fruits. It is this larger serving size of meat used in the adjustment which undoubtedly results in the significance of grade level in the analysis of covariance.

Examination of means adjusted for serving sizes in Table III-21 shows the same trends as the means in Table III-19 which were not adjusted. Except for raw and cooked vegetables and fruit, secondary students left less food than elementary students. For all menu items except meat, lunches prepared and served on site had less plate waste than did preportioned-delivered lunches. Also, males had less plate waste, on the average, than females.

The analysis of covariance on percent consumed as shown in Table III-22 can be compared to the analysis of variance results in Table III-20. Little change is noted except for milk, dessert, and raw vegetables. In the case of milk, analysis of covariance resulted in a significant grade level effect and for dessert items, foodservice system and sex had an effect. For raw vegetables, sex effect became significant.

These trends were similar to the previous analysis of variance and the corrected percent consumption varied little from the uncorrected values, thus, extensive further discussion is not warranted.

Difference in Consumption of Food Item Categories by Foodservice System and Sex:

To better determine the effect of foodservice system on the plate waste of food categories, a series of Student's "t" tests were conducted on the plate waste and percent consumption data for each of the 10 food categories. Tables III-23 and III-24 show plate waste and percent consumption respectively, for males, females and the total sample combined, in the 10 menu item categories as served in elementary schools. The probability that these means are the same is shown below the means. For the total sample the data clearly show that for raw vegetables, cooked vegetables, potatoes/pasta, fruit, dessert and bread, there was significantly greater plate waste and a lower percent consumption (except for dessert) for the preportioned-delivered lunches than for lunches prepared on site.

Tables III-25 and III-26 show plate waste and percent consumption, respectively, for secondary schools for each of the 10 food item categories. The effect of foodservice system is less pronounced in these data for the secondary schools. The lowered significance level is due primarily to two factors. First, there were 70 percent fewer secondary schools than elementary schools in the sample which require greater differences in the means in order to be significant. Also, the secondary students tended to eat more of the food they were served so that the

Table III-23 Serving size and plate waste by elementary students for ten food categories

Food Category	Serving Size			Male			Female			All [1/]		
	On-site		Prepor-tioned-Delivered	On-site		Prepor-tioned-Delivered	On-site		Prepor-tioned-Delivered	On-site		Prepor-tioned-Delivered
						GRAMS						
1. Meat	60.1	-	66.2	7.8	-	8.5	13.7	-	11.7	10.1	-	10.2
2. Raw. veg.	31.4	-	31.0	12.1	0.01[2/]	19.0	14.5	0.05	21.2	13.3	0.05	19.9
3. Cooked veg.	58.4	-	66.8	24.4	0.01	34.8	29.9	0.10	37.9	27.1	0.01	35.8
4. Potatoes/Pasta	83.6	-	75.4	15.0	0.01	28.1	17.3	0.01	33.5	15.6	0.01	30.9
5. Fruit	73.5	-	74.8	9.7	0.001	16.8	13.3	0.03	19.0	11.3	0.002	17.8
6. Desssert	55.8	-	54.4	8.1	0.01	14.0	11.4	-	15.9	9.8	0.01	15.2
7. Bread	42.0	0.01	35.7	3.8	0.01	6.6	6.4	0.01	9.7	5.1	0.01	8.0
8. Milk	251.5	-	251.6	28.1	-	34.1	41.6	-	38.2	34.3	-	35.3
9. Comb. Items	148.2	-	127.4	19.4	-	22.4	25.3	-	28.8	22.0	-	25.3
10. Misc.	20.5	-	13.6	2.1	-	2.5	3.3	-	2.8	2.5	-	2.7

[1/] Totals for all students are weighted averages

[2/] Probability

Table III-24 Serving size and percent consumption by elementary students for ten food categories

Food Category	Serving Size On-site		Serving Size Prepor-tioned-Delivered	Male On-site		Male Prepor-tioned-Delivered	Female On-site		Female Prepor-tioned-Delivered	All [1/] On-site		All [1/] Prepor-tioned-Delivered
	---------Grams---------			---Percent---								
1. Meat	60.1	-	66.2	89.3	-	86.3	79.5	-	81.2	85.4	-	84.3
2. Raw. veg.	31.4	-	31.0	63.7	0.01[2/]	42.1	57.1	0.01	35.3	60.4	0.01	39.3
3. Cooked veg.	58.4	-	66.8	60.9	0.01	44.5	52.9	-	42.2	56.9	0.05	43.5
4. Potatoes/Pasta	83.6	-	75.4	83.8	0.01	65.5	80.7	0.01	60.9	82.9	0.01	63.5
5. Fruit	73.5	-	74.8	86.7	0.001	77.6	81.4	0.04	73.9	84.4	0.001	75.4
6. Dessert	55.8	-	54.4	88.5	0.10	83.3	83.2	-	80.9	86.2	-	81.8
7. Bread	42.0	-	35.6	89.7	0.01	81.8	84.2	0.01	74.4	87.1	0.01	78.4
8. Milk	251.5	-	251.7	88.7	-	86.3	83.3	-	84.7	86.2	-	85.8
9. Comb. Items	148.2	-	127.9	85.1	-	83.8	81.7	-	78.9	83.7	-	81.6
10. Misc.	20.5	-	13.6	86.4	0.01	70.4	80.3	0.05	67.1	84.5	0.01	68.5

[1/] Totals for all students are weighted averages.

[2/] Probability

Table III-25 Serving size and plate waste by secondary students for ten food categories

Food Category	Serving Size			Male			Female			All 1/		
	On-site		Prepor-tioned-Delivered	On-site		Prepor-tioned-Delivered	On-site		Prepor-tioned-Delivered	On-site		Prepor-tioned-Delivered
	---------Grams---------			---------Percent---------								
1. Meat	75.4	-	86.6	4.3	-	8.6	10.4	-	7.9	7.3	-	12.4
2. Raw. veg.	56.2	-	40.6	26.9	-	19.9	26.0	0.05 1/	35.7	26.2	-	28.3
3. Cooked veg.	77.1	0.10	61.3	23.0	0.05	42.6	37.6	-	41.4	28.3	0.10	41.9
4. Potatoes/Pasta	87.4	-	74.7	5.7	0.10	18.2	8.9	-	21.0	7.2	-	19.1
5. Fruit	87.9	-	88.1	22.6	-	28.9	27.7	-	36.1	25.6	-	31.7
6. Dessert	54.5	0.10	38.9	2.2	0.10	5.9	4.5	-	8.8	2.9	0.10	6.9
7. Bread	46.1	-	41.7	3.2	-	7.1	7.3	-	9.0	5.2	-	7.9
8. Milk	260.9	-	262.9	13.0	-	14.4	28.2	-	17.8	19.9	-	15.4
9. Comb. Items	194.0	0.01	121.1	18.4	-	12.4	31.4	-	25.5	24.5	-	17.6
10. Misc.	10.5	-	14.5	1.4	-	3.2	1.3	-	4.8	1.3	-	3.7

1/ Totals for all students are weighted averages

2/ Probability

Table III-26 Serving size and percent consumption by secondary students for ten food categories

Food Category	Serving Size On-site		Serving Size Prepor-tioned-Delivered	Male On-site		Male Prepor-tioned-Delivered	Female On-site		Female Prepor-tioned-Delivered	All 1/ On-site		All 1/ Prepor-tioned-Delivered
	--------Grams--------			---------------------------Percent---------------------------								
1. Meat	75.4	-	86.6	93.3	-	91.4	85.4	-	81.5	89.5	-	87.3
2. Raw veg.	56.2	-	40.6	49.1	-	57.8	48.0	-	45.7	49.0	-	51.9
3. Cooked veg.	77.1	-	61.3	67.1	0.05 2/	39.9	44.8	-	51.6	59.7	0.10	40.6
4. Potatoes/Pasta	87.4	-	74.7	91.6	-	81.1	87.0	-	78.4	89.4	-	80.4
5. Fruit	87.9	-	88.1	74.6	-	68.1	68.1	-	59.4	70.9	-	64.9
6. Dessert	54.5	-	38.9	95.2	-	89.0	88.1	-	82.1	95.2	0.10	85.5
7. Bread	46.1	-	41.7	91.9	-	82.4	82.3	-	77.4	87.3	-	80.5
8. Milk	260.9	-	262.9	95.0	-	95.2	89.2	-	93.6	92.4	-	94.7
9. Comb. Items	194.0	-	121.1	37.7	-	91.6	80.0	-	84.1	80.2	-	88.0
10. Misc.	10.5	-	14.5	85.8	-	73.9	87.0	-	71.5	88.4	-	69.6

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[1] Totals for all students are weighted averages

[2] Probability

variance between foodservice systems in the amount of waste and percent of the food consumed was smaller. Nevertheless, for cooked vegetables and desserts, plate waste was lower and percent consumption was higher, for on-site as compared to preportioned-delivered lunches. Technological factors associated with preportioned-delivered lunches such as long holding times and reheating appear to be significant for lunches prepared for secondary students also. These factors were discussed on pages 60-61.

Differences in Consumption of Frequently Served Menu Items by Foodservice System and Sex:

For the purpose of this analysis, frequently served menu items were defined as those which appear in at least ten lunches served in the study. In most cases, these items were served more often than this minimum number. To give further insight into the effect of foodservice system on frequently served menu items, student's "t" tests were conducted to compare differences in plate waste and percent consumption for males, females, and total students in elementary schools by foodservice system. These results are presented as plate waste and percent consumption in Tables III-27 and III-28, respectively. Similar data are given for secondary students in Tables III-29 and III-30. The tables show that there were relatively few significant differences associated with foodservice system because of the small sample size associated with all but a few of the frequently served menu items. This was especially true for secondary students but the data for elementary students analyzed as plate waste or percent consumption were very similar. Specifically, data in Tables III-27 and III-28 show that for elementary students, peanut butter sandwich (6), green peas (11), corn (12), cole slaw (15), tossed salad (16), whipped potatoes (17), peaches (20), orange juice (22), fruit gelatin (23) and fresh oranges (27) had a lower percent consumption and significantly higher plate waste when served as part of preportioned-delivered lunches than on-site lunches. Similar analysis and data for secondary schools are shown in Tables III-29 and III-30. Because of the small sample size, few significant differences were detected. There was a higher percent consumption of canned green beans and cole slaw for students having lunches prepared on site. Data from these tables show that for elementary and secondary students flavored milk had the higher percent consumption.

Frequency Distribution of Percent Consumption:

To further examine the data used in the Student's "t" test comparisons, the frequency distribution of the percent consumption was examined. Selected examples for food categories and frequently served menu items are shown in Table III-31. These data clearly indicate that the expected or normal distributions of data are not present. The bimodal distributions for individual student percent consumption show that for most items either the student consumed most of the item as served or consumed very little of the item. Clearly, when such reactions to food

Table III-27 Plate waste for thirty menu items frequently served to elementary students

Food Category	Male			Female			All [1/]		
	On-Site	Preportioned-Delivered	P. [2/]	On-site	Preportioned-Delivered	P. [2/]	On-Site	Preportioned-Delivered	P.
	------grams------			------grams------			------grams------		
1. Fish sand.	8.3	9.9	-	17.4	13.9	-	11.6	11.5	-
2. Fish portion	5.3	6.4	-	6.1	9.7	-	5.4	8.5	-
3. Cheese/ham	8.4	5.9	-	16.5	11.5	-	11.6	9.0	-
4. Chicken	18.9	16.4	-	21.7	30.0	-	20.2	25.0	-
5. Hot dogs	10.8	3.0	-	9.1	1.9	-	10.7	2.4	-
6. PB sand.	5.4	34.8	0.01	17.1	36.7	-	11.0	34.5	0.03
7. Meat/cheese sand.	3.7	11.2	-	12.1	17.7	-	7.5	14.2	-
8. Pizza	5.9	8.2	-	9.8	9.1	-	7.6	8.8	-
9. Spaghetti	24.6	21.6	-	39.9	39.4	-	30.6	32.1	-
10. Green beans/Cnd.	21.7	29.5	0.09	24.9	26.9	-	23.8	28.3	-
11. Green peas/Cnd.	28.7	49.8	0.02	37.9	57.5	0.08	32.4	53.7	0.03
12. Corn/Cnd.	9.1	18.6	0.09	10.4	31.6	0.10	9.9	23.3	0.11
13. Cooked carrots	38.1	36.9	-	41.9	37.8	-	29.8	37.6	-
14. Fresh carrots	3.1	5.6	-	2.2	6.5	-	2.7	6.0	-
15. Cole slaw	24.2	36.1	0.10	28.4	38.8	-	26.1	37.2	0.11
16. Tossed salad	13.0	20.4	0.04	15.0	23.1	0.06	13.9	21.2	0.04
17. Whipped potatoes	18.2	38.9	0.02	21.2	42.3	0.04	19.0	40.4	0.02
18. French fries	4.6	6.7	-	5.2	8.4	-	4.8	7.1	-
19. Applesause/Cnd.	15.7	21.2	-	20.3	23.1	-	17.0	22.2	-
20. Peaches/Cnd.	8.3	16.9	0.05	8.4	22.3	0.10	8.2	19.2	0.07
21. Mixed fruit	13.4	17.4	-	19.5	16.2	-	16.5	16.7	-
22. Orange juice	4.0	16.0	-	6.6	23.0	0.03	5.3	20.4	0.04
23. Fruit gelatin	18.4	47.7	0.02	33.7	52.1	-	26.2	50.3	0.06
24. Pineapple/Cnd.	5.4	15.2	-	5.8	16.7	-	5.7	14.3	-
25. Apple/Fresh	19.1	35.0	-	11.4	32.5	-	15.3	34.3	-
26. Banana/Fresh	0.0	10.1	-	0.0	14.5	-	0.0	12.2	-
27. Orange/Fresh	7.0	17.4	0.06	11.5	15.6	-	9.3	16.7	-
28. Whole milk	32.0	38.9	-	48.9	43.1	-	39.8	40.6	-
29. Low fat milk	33.2	17.9	-	44.2	23.0	-	36.1	18.2	-
30. Flavored milk	16.1	14.8	-	24.9	20.3	-	20.4	17.5	-

[1/] Totals for all students are weighted averages

[2/] Probability

Table III-28 Percent consumption for thirty menu items frequently served to elementary students

Food Category	Male			Female			All 1/		
	On-site	Preportioned-Delivered	P. 2/	On-site	Preportioned-Delivered	P. 2/	On-Site	Preportioned-Delivered	P.
	------grams------			------grams------			------grams------		
1. Fish sand.	92.7	86.7	-	81.4	80.9	-	88.6	84.4	-
2. Fish portion	92.3	92.7	-	91.0	89.5	-	92.1	90.6	-
3. Cheese/ham	91.3	93.3	-	81.1	85.8	-	87.1	89.3	-
4. Chicken	75.7	81.7	-	72.1	65.1	-	74.0	71.3	-
5. Hot dogs	90.0	93.4	-	89.3	96.1	-	88.9	94.8	-
6. PB sand.	88.6	60.7	0.02	74.7	51.8	-	82.5	58.9	0.04
7. Meat/cheese sand.	91.7	82.0	-	68.4	74.6	-	81.3	78.5	-
8. Pizza	94.3	93.6	-	91.6	92.2	-	93.2	92.8	-
9. Spaghetti	87.4	86.9	-	80.8	76.6	-	85.0	80.8	-
10. Green beans/Cnd.	56.4	47.5	-	51.0	52.9	-	52.9	49.8	-
11. Green peas/Cnd.	48.7	33.4	-	32.6	23.5	-	42.1	28.4	-
12. Corn/Cnd.	79.8	71.6	-	79.7	54.4	0.10	79.5	65.7	-
13. Cooked carrots	34.9	40.4	-	22.1	39.8	-	29.4	39.8	-
14. Fresh carrots	77.2	72.7	-	81.8	66.2	-	79.1	69.4	-
15. Cole slaw	45.7	29.4	-	39.1	23.1	-	42.6	26.8	0.10
16. Tossed salad	59.4	39.9	0.02	54.4	34.3	0.01	57.0	38.6	0.01
17. Whipped potatoes	82.8	57.8	0.00	80.6	53.5	0.01	82.4	56.2	0.00
18. French fries	92.9	85.5	-	91.5	80.2	0.09	92.4	83.8	-
19. Applesauce/Cnd.	81.8	71.8	0.06	74.6	70.4	-	79.2	70.9	-
20. Canned peaches	87.4	75.2	0.05	87.6	66.8	0.09	87.7	72.2	0.05
21. Mixed fruit	82.3	78.4	-	73.9	79.2	-	78.2	78.8	-
22. Orange juice	95.8	83.8	-	92.9	78.6	0.04	94.5	80.6	0.06
23. Fruit gelatin	82.2	53.0	0.01	67.7	48.4	0.11	74.8	50.4	0.02
24. Pineapple/Cnd.	91.9	77.1	-	90.5	73.2	-	91.1	78.1	-
25. Apple/Fresh	76.3	54.4	-	85.9	63.9	-	91.1	61.1	-
26. Banana/Fresh	100.0	87.6	-	100.0	82.4	-	100.0	85.1	-
27. Orange/Fresh	89.8	69.7	0.07	82.9	70.7	-	86.2	79.5	-
28. Whole milk	86.9	84.2	-	80.0	82.5	-	83.7	83.5	-
29. Low fat milk	86.5	92.7	-	82.0	90.6	-	85.3	92.6	-
30. Flavored milk	93.9	94.4	-	90.6	92.4	-	92.3	93.4	-

1/ Totals for all students are weighted averages. 2/ Probability

Table III-29 Plate waste for thirty menu items frequently served to secondary students

Food Category	Male		P.[2]	Female		P.[2]	All[1]		P.
	On-site	Preportioned-Delivered		On-site	Preportioned-Delivered		On-Site	Preportioned-Delivered	
	------grams------			------grams------			------grams------		
1. Fish sand.	Not enough cases								
2. Fish portion	3.2	.9	-	6.7	8.2	-	4.9	4.1	-
3. Cheese/ham	5.6	5.1	-	11.4	12.7	-	7.9	7.8	-
4. Chicken	1.5	30.8	-	18.0	38.9	-	8.5	34.2	-
5. Hot dogs	2.2	5.3	-	1.6	4.8	-	2.0	4.7	-
6. PB sand.	No record								
7. Meat/cheese sand.	2.4	2.9	-	10.8	3.4	-	5.2	3.1	-
8. Pizza	8.6	1.3	-	15.5	2.4	-	12.4	1.7	-
9. Spaghetti	2.4	7.7	-	12.3	10.2	-	6.7	8.4	-
10. Green beans/Cnd.	31.9	26.9	-	49.5	28.9	-	39.3	26.8	-
11. Green peas/Cnd.	29.4	35.3	-	53.8	39.5	0.07	37.5	37.0	-
12. Corn/Cnd.	22.9	7.7	-	32.3	18.7	-	27.4	12.5	-
13. Cooked carrots	Not enough cases								
14. Fresh carrots	Not enough cases								
15. Cole slaw	39.6	41.3	-	43.5	44.8	-	41.4	42.3	-
16. Tossed salad	21.1	22.7	-	20.9	44.2	-	21.1	34.3	-
17. Whipped potatos	17.0	23.1	-	20.6	28.4	-	18.2	24.3	-
18. French fries	3.5	7.7	-	8.1	17.1	-	5.4	11.5	-
19. Applesauce/Cnd.	19.6	33.4	-	5.3	55.7	0.06	14.6	44.4	-
20. Peaches/Cnd.	8.8	39.9	0.08	27.7	49.9	-	16.0	46.4	-
21. Mixed fruit	37.1	21.8	-	39.5	44.1	-	38.8	30.9	-
22. Orange juice	12.9	16.1	-	18.5	20.3	-	16.6	18.5	-
23. Fruit gelatin	Not enough cases								
24. Pineapple/Cnd.	Not enough cases								
25. Apple/Fresh	Not enough cases								
26. Banana/Fresh	No record								
27. Orange/Fresh	Not enough cases								
28. Whole milk	13.5	14.3	-	23.6	21.7	-	19.0	16.4	-
29. Low fat milk	8.5	6.1	-	19.6	37.7	-	13.1	21.2	-
30. Flavored milk	7.4	8.0	-	26.1	6.6	0.05	13.5	7.2	-

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[1] Totals for all students are weighted averages.

[2] Probability

Table III-30 Percent consumption for thirty menu items frequently served to secondary students

	Male			Female			All 1/		
Food Category	On-site	Preportioned-Delivered	P. 2/	On-site	Preportioned-Delivered	P. 2/	On-Site	Preportioned-Delivered	P.
1. Fish sand.	Not enough cases								
2. Fish portion	97.4	99.2	-	93.2	92.8	-	95.4	96.5	-
3. Cheese/ham	91.9	96.5	-	85.8	91.1	-	89.3	94.0	-
4. Chicken	98.6	78.6	-	82.6	69.2	-	91.8	74.7	-
5. Hot dogs	95.1	95.8	-	96.4	93.8	-	95.5	95.4	-
6. PB sand.	No record								
7. Meat/cheese sand.	98.6	94.2	-	93.7	93.7	-	97.0	94.1	-
8. Pizza	93.3	99.1	-	87.8	98.4	-	90.3	98.9	-
9. Spaghetti	98.9	93.7	-	94.0	91.6	-	96.8	93.1	-
10. Green beans/Cnd.	56.5	55.3	-	33.3	51.4	-	47.4	55.3	-
11. Green peas/Cnd.	59.2	29.8	-	20.3	20.6	-	47.9	26.2	0.11
12. Corn/Cnd.	75.3	87.6	-	62.4	69.8	-	69.2	79.9	-
13. Cooked carrots	Not enough cases								
14. Fresh carrots	Not enough cases								
15. Cole slaw	43.7	26.6	-	39.2	12.7	0.03	41.9	22.9	0.05
16. Tossed salad	54.3	56.9	-	54.8	40.5	-	54.5	48.2	-
17. Whipped potatoes	85.2	76.7	-	80.8	71.5	-	83.3	75.6	-
18. French fries	93.9	89.8	-	85.6	77.5	-	90.3	84.9	-
19. Applesauce/Cnd.	74.0	66.9	-	92.9	39.9	0.07	80.9	53.6	-
20. Peaches/Cnd.	89.6	70.0	0.10	65.1	62.5	-	80.3	65.1	-
21. Mixed fruit	58.4	73.8	-	55.4	47.7	-	56.6	63.0	-
22. Orange juice	86.9	85.3	-	83.8	81.6	-	84.2	83.1	-
23. Fruit gelatin	Not enough cases								
24. Pineapple/Cnd.	Not enough cases								
25. Apple/Fresh	Not enough cases								
26. Banana/Fresh	Not enough cases								
27. Orange/Fresh	Not enough cases								
28. Whole Milk	94.6	95.5	-	90.7	92.3	-	92.5	94.5	-
29. Low fat milk	96.6	97.5	-	92.0	84.7	-	94.7	91.4	-
30. Flavored milk	97.3	97.1	-	90.4	97.6	0.05	95.0	97.4	-

1/ Totals for all students are weighted averages

2/ Probability

Table III-31 Frequency distribution of the percent consumption of selected foods for all students

Percent Consumption	Raw Vegetable On-site	Raw Vegetable Preportioned-Delivered	Cooked Vegetable On-site	Cooked Vegetable Preportioned-Celivered	Chicken On-site	Chicken Preportioned-Delivered	Tossed salad On-site	Tossed salad Preportioned-Delivered	Whipped potatoes On-site	Whipped potatoes Preportioned-Delivered
100	36.6	37.2	33.7	23.8	48.6	33.8	34.3	19.7	59.1	28.0
90 - 99	3.6	1.6	7.2	6.8	7.6	8.1	4.1	1.9	10.0	15.2
80 - 89	3.1	2.1	4.5	2.3	7.6	6.9	3.7	3.9	5.9	5.6
70 - 79	3.6	1.7	3.4	1.4	9.5	8.1	4.2	3.9	3.1	5.6
60 - 69	3.9	1.8	2.8	1.9	6.7	8.1	4.6	2.7	2.5	1.7
50 - 59	4.1	2.9	2.6	1.5	5.7	6.9	4.2	4.9	2.7	2.8
40 - 49	4.8	3.9	3.6	2.1	2.9	7.5	4.2	6.1	2.7	3.0
30 - 39	6.3	5.0	4.4	3.7	2.9	8.8	5.1	5.8	2.5	2.8
20 - 29	6.6	7.8	7.6	7.8	8.6	3.8	5.4	8.5	3.1	3.9
10 - 19	7.8	8.2	7.1	13.5	0.0	3.1	7.8	14.6	2.9	6.0
0 - 9	19.7	28.0	23.1	35.3	0.0	5.0	22.5	28.2	5.4	25.6

Percent Consumption	Peanut but. sand. On-site	Peanut but. sand. Preportioned-Delivered	Cooked carrots On-site	Cooked carrots Preportioned-Delivered	Fresh Carrots On-site	Fresh Carrots Preportioned-Delivered	Fruit Gelatin On-site	Fruit Gelatin Preportioned-Delivered	Fresh Orange On-site	Fresh Orange Preportioned-Delivered
100	74.7	28.3	14.4	21.7	60.0	56.6	52.0	26.0	57.3	30.2
90 - 99	1.7	1.7	1.1	5.3	1.7	2.0	10.8	15.3	19.7	19.3
80 - 89	3.0	3.3	0.0	0.0	0.8	2.0	2.9	3.4	3.4	8.1
70 - 79	4.2	13.3	0.0	0.9	2.5	1.5	2.9	1.7	3.4	9.8
60 - 69	3.4	10.0	0.0	1.8	8.3	1.0	5.9	0.4	2.6	2.0
50 - 59	3.0	5.0	4.4	1.8	4.2	2.5	3.9	3.0	0.0	2.0
40 - 49	1.3	6.7	2.2	3.5	5.8	3.0	2.9	3.4	3.4	3.7
30 - 39	2.1	5.0	13.3	3.1	2.5	8.1	1.0	0.4	1.7	4.1
20 - 29	2.1	3.3	12.2	12.0	2.5	6.1	3.9	4.3	3.4	2.0
10 - 19	1.7	10.0	14.4	21.7	4.2	3.0	5.9	4.7	1.7	4.8
0 - 9	3.0	13.3	37.8	28.3	7.5	14.1	7.8	37.5	3.4	13.9

exist for the majority of students, it appears advisable to offer students choices of alternate menu items so that the probability increases that they will be served an item they like and therefore will consume to a greater extent. The Washington State University study (14) recommended that students be offered a choice of selections especially in the fruit and vegetable categories as well as when ethnic or culturally different foods are served. The school lunch offer-versus-serve provision initiated in secondary schools in the fall of 1976 recognizes the bimodal distribution in individual food consumption by allowing students to refuse components in the Type A lunch they do not intend to consume. School lunch programs which offer choice and/or have implemented the offer-versus-serve provision should have lower plate waste than those which serve a single Type A lunch with no possibility of choice. Many secondary schools have recognized the above conditions and have taken important steps to offer sandwiches and/or hamburgers, Type A salads, and other similar foods as choices available each day, to the more conventional Type A lunch. Provision of choices at the elementary level would appear desirable also. On-site preparation and service may lend itself more easily to the choice situation, but preportioned-delivered lunches should not preclude some choice possibilities.

Table III-31 also shows that students seem to prefer some raw to cooked vegetables. This would suggest that raw vegetables might be served more frequently than cooked vegetables. Vegetables such as carrots, cauliflower, and celery are good examples. The data for cooked and fresh carrots are given, which illustrate the above point. Specifically, 58 percent of the students consumed 100 percent of the raw carrots served, while only 17 percent of the students consumed 100 percent of the cooked carrots.

Foods such as chicken, whipped potatoes, peanut butter sandwich, fruit gelatin, tossed salad and fresh orange showed marked changes in percent consumption as a function of foodservice system. In each of these cases, the preportioned-delivered food had poorer consumption than the on-site prepared food. Twenty-five percent of the students consumed less than 10 percent of the potatoes served in preportioned-delivered lunches as compared to 5 percent of the students who consumed less than 10 percent of the potatoes in the on-site lunches. This indicates that menu planners must consider the acceptability of all menu items, even those generally regarded as popular.

Distribution of Lunches that Satisfied the Type A Requirements by Components:

Further analysis was conducted to determine the distribution of lunches that satisfied each component of the pattern. (See Table III-32.) The Type A Pattern contains minimum serving requirements for the various food components. The standard used in this analysis was based on these minimum requirements and did not reflect the larger serving sizes recommended for older children; therefore, only the data for elementary school students

Table III-32 Lunches meeting Type A Pattern requirements by components as served and consumed in elementary schools

Pct. Satisfied	Meat/Meat Alternate On-site	Meat/Meat Alternate Preportioned-Delivered	Meat/Meat Alternate Total	Vegetable/Fruit On-site	Vegetable/Fruit Preportioned-Delivered	Vegetable/Fruit Total	Milk On-site	Milk Preportioned Delivered	Milk Total
	--Percent of total meals--								
					As served				
119	15.6	13.6	14.6	33.6	29.2	31.4	0.0	0.0	0.0
100 - 119	18.8	33.6	26.2	18.4	27.5	23.0	96.1	99.3	97.7
100+	34.3	47.2	40.8	52.0	56.7	54.4	96.1	99.3	97.7
90 - 99	20.9	14.9	17.9	11.9	12.4	12.2	0.0	0.0	0.0
80 - 89	9.0	15.0	12.0	6.5	13.3	9.9	1.8	0.0	0.0
70 - 79	17.8	11.9	14.8	14.7	7.3	11.0	0.0	0.0	0.0
60 - 69	8.7	4.8	6.7	6.7	6.3	6.5	0.0	0.0	0.0
50 - 59	3.9	5.0	4.4	2.7	1.3	2.0	0.0	0.0	0.0
40 - 49	5.0	0.0	2.5	4.0	0.0	2.0	0.0	0.0	0.0
30 - 39	0.2	1.3	0.7	1.4	2.7	2.0	0.0	0.0	0.0
20 - 29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 - 19	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
0 - 9	0.1	0.0	0.1	0.0	0.0	0.0	2.1	0.7	1.4
OBSERVATIONS	2330.	2369.	4699	2330.	2369.	4699.	2330.	2369.	4699.
					As consumed				
119	8.0	10.1	9.1	13.0	3.2	8.1	0.0	0.0	0.0
100 - 119	15.3	17.4	16.4	8.8	9.6	9.2	63.0	61.3	62.1
100+	23.5	27.5	25.5	22.2	13.0	17.6	63.0	61.3	62.1
90 - 99	17.0	13.3	15.2	6.6	7.0	6.8	6.7	10.6	8.7
80 - 89	7.9	14.5	11.2	6.7	7.3	7.0	4.8	3.5	4.2
70 - 79	15.4	10.8	13.1	11.8	8.9	10.4	2.7	3.0	2.9
60 - 69	8.5	7.9	8.2	11.4	11.6	11.5	2.9	2.8	2.8
50 - 59	6.7	6.8	6.8	8.7	8.8	8.7	3.0	2.3	2.7
40 - 49	5.6	2.8	4.2	9.8	9.8	9.8	2.0	1.8	1.9
30 - 39	3.8	3.8	3.8	7.3	11.4	9.3	1.8	1.7	1.8
20 - 29	3.6	2.2	2.9	4.5	6.5	5.5	1.9	1.1	1.5
10 - 19	2.0	2.0	2.0	3.6	4.2	3.9	0.9	0.9	0.9
0 - 9	6.1	8.2	7.2	7.8	11.6	9.7	10.2	10.9	10.6
OBSERVATIONS	2330.	2369.	4699.	2330.	2369.	4699.	2330.	2369.	4699.

"Continued"

Table III-32 Lunches meeting Type A Pattern requirements by components as served and consumed in elementary schools--Continued

Pct. Satisfied	Bread On-site	 Preportioned-Delivered	 Total	Butter/Margarine On-site	 Preportioned-Delivered	 Total
	--------------------Percent	of total	meals--------------------			
			As served			
119	65.2	68.3	66.8	43.6	50.0	47.2
100 - 119	12.7	15.0	13.9	12.4	16.0	14.2
100+	77.9	83.2	80.6	55.9	66.9	61.4
90 - 99	5.7	4.8	5.3	7.7	5.0	6.4
80 - 89	7.5	4.7	6.1	3.9	2.5	3.2
70 - 79	2.9	2.5	2.7	1.3	4.6	3.0
60 - 69	22.6	3.8	3.2	4.6	2.5	3.6
50 - 59	0.0	0.0	0.0	2.0	3.8	2.9
40 - 49	0.3	1.0	0.6	3.9	1.3	2.6
30 - 39	0.0	0.0	0.0	1.3	0.0	0.6
20 - 29	0.0	0.0	0.0	4.6	0.0	2.3
10 - 19	0.0	0.0	0.0	2.9	1.3	2.1
0 - 9	3.0	0.0	1.5	12.0	12.1	12.0
OBSERVATIONS	2330.	2369.	4699.	2330.	2369.	4699.
			As consumed			
119	54.8	51.6	53.2	33.3	32.0	32.6
100 - 119	12.6	14.6	13.6	10.1	10.5	10.3
100+	67.4	66.3	66.9	43.3	42.7	43.1
90 - 99	6.1	4.4	5.2	6.3	3.8	5.0
80 - 89	7.2	5.1	6.2	4.9	3.0	4.0
70 - 79	3.3	3.3	3.3	5.0	4.4	4.7
60 - 69	3.1	4.1	3.6	5.2	4.3	4.7
50 - 59	1.3	1.5	1.4	4.4	5.6	5.0
40 - 49	0.9	1.3	1.1	4.5	3.3	3.9
30 - 39	1.1	1.6	1.3	1.6	1.4	1.5
20 - 29	1.1	0.9	1.0	3.5	4.3	3.9
10 - 19	1.3	2.4	1.6	3.2	2.4	2.8
0 - 9	7.2	9.2	8.2	18.1	25.2	21.6
	2330.	2369.	4699.	2330.	2369.	4699.

are shown. In approximately 29 percent of the total lunches, the serving size for the meat/meat alternate component was less than 80 percent of the requirement; almost 41 percent satisfied the requirement but in about 15 percent, the serving size was greater than 119 percent of the requirement. Almost 24 percent of the lunches achieved less than 80 percent of the serving size for the vegetable/fruit component; 54 percent satisfied this requirement but 31 percent or almost one-third of the total lunches contained greater than 119 percent of the vegetable/fruit requirement. Only 8 percent of the lunches achieved less than 80 percent of the bread requirement and 29 percent of the lunches were below this level for the butter/fortified margarine requirement but approximately 50 percent of the lunches had serving sizes for either of these two components greater than 119 percent of the requirement. Milk was the only component that was routinely provided in amounts that were consistent with the pattern requirements. This was due to the one-half pint container of milk that is served in a Type A lunch.

Those lunches which had a serving size above 119 percent of the requirement for a given component, were taken as an indication that the serving size was excessive. Even though some serving sizes were in excess of the requirement for all food components except milk, percent consumption was higher for meat/meat alternate, bread and butter/margarine. However, consumption for fruit and vegetables, especially vegetables, was low. For the meat/meat alternate component the difference between the lunches served and consumed at the higher level (serving size above 119 percent of the requirements) was about 6 percent; bread, about 14 percent and butter/margarine, about 15 percent. However, the vegetable/fruit component had a difference of about 23 percent. So it appears that if students are served portions which exceed the requirements, this could be a factor causing plate waste, especially for fruits and vegetables. Previous data also support this conclusion. (See Table III-25.)

Other Factors Affecting Plate Waste:

Many factors can contribute to changes in the quantity of food consumed by students participating in a school lunch program. Factors such as the availability of the School Breakfast Program, the availability of competitive foods, lunchroom manager input in menu planning, extent of the menu planners' training and student involvement in menu planning were explored in this study to determine their effect on percent consumption and average daily participation. However, the data collected on these factors (except the availability of the School Breakfast Program) were insufficient to analyze their effects on consumption and participation.

Table III-33 shows the effect the availability of breakfast has on percent consumption and percent participation in the school lunch program.

Table III-33 Student participation and consumption of lunches as affected by the service of breakfast

	Consumption of Lunch	Lunch Participation
	---------Percent---------	
Elementary Schools		
With Breakfast	72.2	75.5
Without Breakfast	80.8	61.9
Probability	0.01	03.0
Secondary Schools		
With Breakfast	86.4	25.5
Without Breakfast	81.8	60.5
Probability	-	-

Breakfast was served in five elementary schools and three secondary schools for each foodservice system. Where breakfast was served in elementary schools, data show that there was a lower percent of food consumed but increased student participation in the school lunch. In the six schools at the secondary level breakfast seems to have had the opposite effect on participation to that noted at the elementary level. There was a lower student participation and a higher percent of food consumed. Because of these reversals in the trends from elementary to secondary levels, it appears that further definitive studies need to be made to assess the effects of breakfast on student participation and consumption of the lunch.

Many factors in addition to those listed above influence student acceptability of lunches and participation. A more defined study must be designed to more clearly determine in-school factors which influence school lunch.

(c) Nutritional Quality of Lunches

The nutritional quality of school lunches as served and as consumed has been evaluated both in terms of nutrients per lunch and in terms of the percentage success in achieving the nutrient standard of one-third of the RDA. In addition, since the nutrient levels of different menu items vary substantially, percentages of consumption of lunches by weight were compared with the percentages of consumption of food energy and the indicator nutrients. Finally, the nutritional quality of lunches that completely met portion size requirements specified in the Type A Pattern was compared with lunches that failed to meet these portion size constraints.

Nutritional Levels in Lunches as Served and Consumed:

In Table III-34, the nutrients per lunch as served in on-site foodservice systems are compared with the nutrient levels in preportioned-delivered lunches by grade level. The probability of the nutrients in the two foodservice systems being the same, as determined by Student's "t" test is indicated. In interpreting these probabilities, it is important to keep in mind that there were approximately three times as many elementary as secondary schools in the study.

In elementary schools, on-site lunches as served, had significantly higher levels of food energy and iron, but foodservice system was not associated with a significant difference in the levels of other nutrients. In the secondary schools, there were no significant differences in the nutrient levels in the lunches as served in the two foodservice systems. As shown in Table III-35, nutrient levels in lunches as served in secondary schools were significantly higher than in lunches served in elementary schools with the exception of calcium and vitamin A. These results are consistent with the serving size data presented in Tables III-23 and III-25. Calcium is supplied in large part by the 1/2 pint of milk served both grade levels which may have accounted for a lack of significant differences. Vitamin A comes from a number of menu items, but especially from dark green or yellow vegetables and fortified milk; however, vegetable consumption is very low by both elementary and secondary students, thus, vegetables are probably served in minimal portions at both grade levels. The data in Table III-34 also show that the percentage of calories supplied by fat was not significantly different in elementary than in secondary school lunches.

Although the average percent of calories derived from fat in lunches as served in approximately 39 percent in both systems for both grade levels, the percent of calories from fat in the lunches ranged between 25 percent to above 50 percent. Table III-36 shows this distribution for lunches as served and Table III-37 shows these data for lunches as consumed. Over one-fourth of the elementary school lunches as served (29 percent for on-site and 22 percent for preportioned-delivered lunches) provided between 40 and 45 percent of the total calories from fat. One-third of the lunches from secondary schools were in this range (24 percent for on-site and 43 percent for preportioned-delivered). Almost 23 percent of the elementary school lunches and over 11 percent of the secondary school lunches provided 45 percent of the total calories from fat. The results from the ARS study (53) on school lunches showed that the total calories from fat averaged 38.8 percent for the 300 schools with a range of 27.2 to 54.4 percent. In nearly 90 percent of the sample, 33 to 44 percent of the calories were contributed by fat.

The nutrients per on-site lunch as consumed are compared with corresponding levels in preportioned-delivered lunches by grade level in Table III-38. In elementary schools, the on-site lunches as consumed furnished significantly higher levels of protein, fat, iron, thiamin, niacin, and

Table III-34 Nutrients in on-site vs preportioned-delivered lunches as served, by grade level

Nutrient	Elementary			Secondary		
	On-site	Preportioned-Delivered	P. [1/]	On-site	Preportioned Delivered	P.
Food Energy (Kcal)	749.	705.	0.05	816.	834.	-
Protein (g)	29.5	28.8	-	33.8	31.6	-
Fat (g)	33.6	31.2	-	34.5	36.6	-
Iron (mg)	4.06	3.70	0.07	4.48	4.46	-
Calcium (mg)	464.	468.	-	478.	463.	-
Phosphorus (mg)	515.	518.	-	578.	562.	-
Vitamin C (mg)	27.3	28.6	-	36.1	35.8	-
Vitamin A (I.U.)	2220.	2360.	-	2470.	2300.	-
Riboflavin (mg)	.770	.756	-	.829	.814	-
Thiamin (mg)	.402	.399	-	.432	.472	-
Niacin (meq)	10.4	9.87	-	12.2	11.3	-
% Cal from Fat	39.8	39.4	-	38.2	39.5	-

[1/] Probability

Table III-35 Nutrients in lunches as served to all elementary vs all secondary students

Nutrient	Elementary	Secondary	P. 2/
Food Energy (Kcal)	726	824	0.00
Protein (g)	29.1	32.8	0.00
Fat (g)	32.4	35.5	0.07
Iron (mg)	3.88	4.47	0.01
Calcium (mg)	446	471	-
Phosphorus (mg)	516	571	0.00
Vitamin C (mg)	28.0	35.9	0.02
Vitamin A (I.U.)	2290	2400	-
Riboflavin (mg)	.763	.822	0.01
Thiamin (mg)	.401	.450	0.01
Niacin (meq)	10.1	11.8	0.00
% Cal from Fat	39.6	38.8	-

1/ Probability

Table III-36 Percent of calories from fat in on-site vs preportioned-delivered lunches as served, by grade level

Percent of Calories from Fat	Elementary			Secondary			All[1]
	On-Site	Preportioned-Delivered	Total[1]	On-Site	Preportioned-Delivered	Total[1]	Lunches
> 50.0	6.28	5.07	5.67	0.56	0.15	0.36	4.48
45.0 - 50.0	13.47	21.02	17.23	8.90	13.64	11.17	15.87
40.0 - 45.0	28.79	22.37	25.59	24.34	43.18	33.36	27.34
35.0 - 40.0	31.26	26.89	29.08	33.38	24.85	29.30	29.13
30.0 - 35.0	15.56	13.85	14.71	27.12	13.94	20.81	16.08
25.0 - 30.0	3.35	4.09	3.72	4.59	1.36	3.05	3.57
<25.0	1.30	6.71	3.99	1.11	2.88	1.96	3.54
Number of Lunches	2390	2369	4759	719	660	1379	6138

[1] Totals for all students are weighted averages

Table III-37 Percent of calories from fat in on-site vs. preportioned-delivered lunches as consumed, by grade-level

Percent of Calories from Fat	Elementary			Secondary			All [1]
	On-Site	Preportioned-Delivered	Total [1]	On-Site	Preportioned-Delivered	Total [1]	Lunches
> 50	6.07	9.29	7.67	2.23	2.58	2.39	6.48
45.0 - 50.0	14.10	17.22	15.65	9.60	17.73	13.49	15.17
40.0 - 45.0	25.94	22.46	24.21	25.45	37.88	31.40	25.82
35.0 - 40.0	32.34	21.74	27.06	31.29	25.30	28.43	27.37
30.0 - 35.0	15.48	17.14	16.31	21.70	11.52	16.82	16.42
25.0 - 30.0	4.14	4.77	4.45	8.62	2.58	5.73	4.74
< 25.0	1.92	7.39	4.63	1.11	2.42	1.74	3.99
Number of Lunches	2390	2369	4759	719	660	1379	6138

[1] Totals for all students are weighted averages

Table III-38 Nutrients in on-site vs preportioned-delivered lunches as consumed, by grade level

	Elementary			Secondary		
Nutrient	On-site	Preportioned-Delivered	P. 1/	On-site	Preportioned Delivered	P.
Food Energy (Kcal)	620	557	0.00	704	699	-
Protein (g)	24.5	23.3	0.01	29.5	27.4	0.05
Fat (g)	27.8	24.4	0.00	29.8	31.1	-
Iron (mg)	3.26	2.84	0.00	3.78	3.62	-
Calcium (mg)	386	382	-	422	414	-
Phosphorus (mg)	426	419	-	506	492	-
Vitamin C (mg)	21.3	18.9	-	27.1	24.6	-
Vitamin A (I.U.)	1530	1400	-	1820	1550	-
Riboflavin (mg)	.642	.624	-	.732	.723	-
Thiamin (mg)	.329	.311	0.05	.372	.389	-
Niacin (meq)	8.59	7.80	0.00	10.5	9.56	0.04
% Cal from Fat	39.7	38.9	-	38.3	40.3	0.02

1/ Probability

food energy than did the preportioned-delivered lunches. In secondary schools on-site lunches as consumed were significantly higher in protein and niacin, and significantly lower in the percent of calories supplied by fat than were preportioned-delivered lunches. However, these significant differences in nutrient levels as a function of foodservice system were fairly small.

As listed in Table III-39, nutrient levels in lunches as consumed by students in either elementary or secondary schools did not generally differ according to sex. The exceptions were all in elementary schools where males consumed significantly higher levels of protein, phosphorus, riboflavin and food energy than females.

Levels of nutrient intake by elementary students are compared with corresponding values for secondary school students for males and/or females in Table III-40. Secondary students had significantly higher levels of calcium intake than elementary students. This observation is consistent with the observation that secondary students consumed a significantly higher percentage of milk served than elementary students. (See page 60.)

Nutrient Levels as Compared to a Nutrient Standard:

The nutrient goal of the Type A lunch is that the lunch should supply one-third of the RDA for required nutrients except for food energy. However, for this study this section compares the nutritional quality of the lunches with a nutrient standard of one-third of the RDA for all indicator nutrients and food energy and a maximum constraint for percent of calories from fat. (In the preceding section, the nutritional quality of the lunches was examined in terms of nutrients per lunch.)

The nutrient standard for the levels of food energy, protein, fat, iron, calcium, phosphorus, vitamin C, vitamin A, riboflavin, thiamin and niacin that should be present in each school lunch served to the specified age groups included in the study are listed in Table III-41. A standard of less than one-third the RDA for food energy for lunches is believed to be desirable. First of all, lunches providing one-third or more of the RDA for food energy may well contribute to many children either overeating or consuming only a portion of the food served to them. Secondly, many students eat other meals and snacks which frequently provide more than two-thirds of their daily needs. Obesity resulting from an oversupply of food energy is a major nutritional concern in this country, even among children.

It is important to keep in mind that there are 40 required nutrients, but it has been possible to set RDA for only a limited number of nutrients. The ten nutrients listed in Table III-41 are considered to be indicator nutrients. Food consumption data are not extensive enough to enable the levels of other required nutrients in the lunches to be calculated. However, the principle of RDA is that when meals are planned from a

Table III-39 Nutrients in lunches consumed by males vs females, by grade level

Nutrient	Elementary				Secondary			
	Male	Female	Total 1/	p. 2/	Male	Female	Total	P.
Food Energy (Kcal)	605	568	589	0.03	727	674	704	-
Protein (g)	24.6	23.1	24.0	0.03	29.5	27.5	28.7	-
Fat (g)	26.8	25.2	26.1	-	31.4	29.3	30.5	-
Iron (mg)	3.15	2.92	3.05	-	3.87	3.53	3.72	-
Calcium (mg)	394	374	385	-	428	408	419	-
Phosphorus (mg)	435	409	474	0.04	513	483	501	-
Vitamin C (mg)	20.7	19.4	20.1	-	27.2	24.5	26.1	-
Vitamin A (I.U.)	1520	1400	1470	-	1820	1560	1710	-
Riboflavin (mg)	.649	.614	.634	0.05	.748	.706	.730	-
Thiamin (mg)	.331	.309	.320	-	.394	.364	.381	-
Niacin (meq)	8.45	7.90	8.21	-	10.4	9.66	10.1	-
% Cal from Fat	39.3	39.3	39.3	-	39.1	39.4	39.2	-

1/ All totals are weighted averages

2/ Probability

Table III-40 Nutrients in lunches consumed by elementary vs secondary students, by sex

Nutrient	Male			Female			All 1/		
	Elem.	Second.	P. 2/	Elem.	Second.	P.	Elem.	Second.	P.
Food Energy (kcal)	605	727	0.00	568	674	0.00	589	704	0.00
Protein (g)	24.6	29.5	0.00	23.1	27.5	0.00	24.0	28.7	0.00
Fat (g)	26.8	31.4	0.00	25.2	29.3	0.00	26.1	30.5	0.00
Iron (mg)	3.15	3.86	0.00	2.92	3.53	0.00	3.05	3.72	0.00
Calcium (mg)	394	428	0.03	374	408	0.04	385	419	0.03
Phosphorus (mg)	435	513	0.00	409	483	0.00	424	501	0.00
Vitamin C (mg)	20.7	27.2	0.02	19.4	24.5	0.05	20.1	26.1	0.02
Vitamin A (I.U.)	1520	1820	-	1400	1560	-	1470	1710	-
Riboflavin (mg)	.649	.748	0.00	.614	.706	0.00	.634	.730	0.00
Thiamin (mg)	.331	.394	0.00	.308	.364	0.00	.320	.381	0.00
Niacin (meq)	8.45	10.4	0.00	7.90	9.66	0.00	8.21	10.1	0.00
% Cal from Fat 39.3	39.1	-	39.3.	39.4	-	39.3	39.2	-	

1/ Totals for all students are weighted averages

2/ Probability

Table III-41 Nutrient standards for elementary vs secondary student, by sex

	Elementary School		Secondary School			
	Grade 5 1/		Grade 9 2/		Grade 10 3/	
Nutrient	Male	Female	Male	Female	Male	Female
Food Energy (Kcal)	844	800	933	800	1000	700
Protein (g)	12.9	12.9	14.7	14.7	18.0	16.0
Fat (g)	37.5	35.6	41.5	35.6	44.4	31.1
Iron (mg)	4.2	4.2	6.0	6.0	6.0	6.0
Calcium (mg)	311	311	400	400	400	400
Phosphorus (mg)	311	311	400	400	400	400
Vitamin C (mg)	13.9	13.9	15.0	15.0	15.0	15.0
Vitamin A (I.U.)	1289	1178	1667	1333	1667	1333
Riboflavin (mg)	0.43	0.41	0.50	0.43	0.60	0.47
Thiamin (mg)	0.42	0.40	0.47	0.40	0.50	0.37
Niacin (meq)	5.6	5.3	6.0	5.3	6.7	4.7
% Cal from Fat	40.0	40.0	40.0	40.0	40.0	40.0

1/ One-third of RDA for ages 9 to 11 (interpolated from mid-points of 7-10 and 11-14 age groups)

2/ One-third RDA for ages 11-14

3/ One-third RDA for ages 15-18

variety of foods to meet the recommended levels of these indicator nutrients, other nutrients will also be provided in sufficient quantities.

In Table III-42 the average nutrient levels per on-site lunch as served are shown as a percent of the appropriate nutritional standards for male and female elementary and secondary students. Corresponding data for preportioned-delivered lunches are shown in Table III-43. The significance level of the differences from the standard are listed as probabilities of the null hypothesis being true as determined by Student's "t" test.

On-site lunches as served in elementary schools contained significantly less food energy than the standard for males and females. In contrast, the levels of protein, calcium, phosphorus, vitamin C, vitamin A, riboflavin and niacin levels were all significantly higher than the standard for both males and females. Thiamin and iron levels did not differ significantly from the standard for males and females in elementary school lunches as served. Although the amount of the fat in lunches was significantly lower than the standard, as was food energy, the calories supplied by fat did not differ significantly from the constraint of not more than 40 percent.

Table III-42 Percent of nutrient standards for on-site lunches as served, by sex and grade level

	Elementary						Secondary					
Nutrient	MALE	P. [1]	FEMALE	P.	TOTAL [2]	P.	MALE	P.	FEMALE	P.	TOTAL	P.
Food Energy	88.9	.00	93.4	.00	91.1	.00	85.8	.00	106.3	-	94.8	-
Protein	229.1	.00	282.2	.00	228.6	.00	217.1	.00	224.0	.00	220.5	.00
Fat	89.8	.01	94.4	-	92.1	.05	81.5	.00	101.3	-	90.2	.01
Iron	96.4	-	96.2	-	96.3	-	75.0	.01	74.3	.01	74.7	.01
Calcium	149.7	.00	148.5	.00	149.1	.00	119.4	.01	118.9	.01	118.4	.01
Phosphorus	165.9	.00	164.9	.00	165.4	.00	144.6	.01	144.3	.01	144.6	.01
Vitamin C	196.4	.00	196.8	.00	196.4	.01	241.4	.01	240.2	.01	240.5	.01
Vitamin A	172.8	.00	188.2	.01	180.0	.00	149.0	.04	184.0	.04	164.9	.02
Riboflavin	179.7	.00	187.5	.00	183.4	.00	157.2	.00	187.2	.00	172.8	.00
Thiamin	95.8	-	100.3	-	98.0	-	90.3	.02	110.5	.05	100.5	-
Niacin	187.5	.00	195.4	.00	191.5	.00	196.2	.00	239.3	.00	215.1	.00
Fat Constraint	99.6	-	99.6	-	99.6	-	95.4	.10	95.5	.10	95.4	.10

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[1] Probability

[2] All totals are weighted averages.

Table III-43 Percent of nutrient standards for preportioned-delivered lunches as served, by sex and grade level

	Elementary						Secondary					
Nutrient	MALE	P. [1]	FEMALE	P.	TOTAL [2]	P.	MALE	P.	FEMALE	P.	TOTAL	P.
Food Energy	83.5	.00	88.1	.00	85.7	.00	87.8	.01	108.3	.06	96.7	-
Protein	223.7	.00	223.8	.00	223.8	.00	204.5	.00	211.8	.00	207.7	.00
Fat	83.0	.01	87.7	.01	85.3	.01	86.7	.01	107.0	-	95.5	-
Iron	87.7	.00	87.5	.00	87.6	.00	74.3	.01	74.5	.01	74.3	.01
Calcium	150.3	.00	150.5	.00	150.4	.00	115.5	.01	116.5	.01	115.7	.01
Phosphorus	166.4	.00	166.5	.00	166.4	.00	140.3	.01	141.1	.01	140.4	.01
Vitamin C	206.0	.01	205.8	.01	205.9	.00	238.5	.01	238.6	.01	238.6	.01
Vitamin A	183.1	.00	200.2	.01	191.3	.00	137.6	-	173.5	-	153.5	-
Riboflavin	175.8	.00	184.6	.00	180.1	.00	155.3	.00	185.5	.00	170.5	.00
Thiamin	95.2	.08	99.9	-	97.5	-	98.8	-	121.0	.01	109.8	-
Niacin	177.4	.00	185.2	.01	181.4	.01	183.5	.00	221.6	.00	200.1	.00
Fat Constraint	98.5	-	98.8	-	98.6	-	98.5	-	99.0	-	98.7	-

[1] Probability

[2] All totals are weighted averages.

Corresponding nutrient levels as a percent of the standard for preportioned-delivered lunches as served are shown in Table III-43. These differences are similar to those noted for on-site lunches except that the deficiency in food energy is greater, and in contrast to on-site lunches, the iron content of preportioned-delivered lunches as served was significantly lower than the standard.

A similar picture was obtained for the secondary schools with a few important differences. As shown in Table III-42 on-site lunches as served in secondary schools furnished levels of protein, calcium, phosphorus, vitamin C, vitamin A, riboflavin and niacin that were significantly higher than the standard for males and females. The iron content of on-site lunches was significantly lower than the standard for both sexes, while the thiamin content was significantly lower than the standard for males and higher than the standard for females. Food energy and fat were also lower than the standard for males but not for females, although differences from the constraint of 40 percent of the calories supplied by fat in secondary school lunches were only of borderline significance.

As shown in Table III-43 preportioned-delivered lunches as served in secondary schools showed similar differences from the standard as did on-site lunches with several minor exceptions. Preportioned-delivered lunches served to males were deficient in food energy as compared to the nutrient standard and for both sexes were higher but not significantly higher than the standard in vitamin A content.

In Tables III-44 and III-45, corresponding data are presented in which the nutrient levels in on-site and preportioned-delivered lunches as consumed are compared with the nutrient standard. In elementary schools, on-site or preportioned-delivered lunches, as consumed, supplied levels of protein, calcium, phosphorus, vitamin C, vitamin A, riboflavin and niacin significantly higher than the standard for males and females. In contrast, intake levels of thiamin, iron, and food energy were significantly less than the standard for both sexes for both foodservice systems. As was the case for the lunches as served, in lunches as consumed, the percentage of calories from fat did not differ significantly from the constraint of 40 percent.

In secondary schools, on-site or preportioned-delivered lunches as consumed by males and females exceeded the nutrient standard in protein, phosphorus, vitamin C, riboflavin and niacin. Intake levels of calcium and vitamin A did not differ significantly from the standard for either foodservice system. As was the case for elementary schools, in secondary schools, on-site or preportioned-delivered lunches as consumed by males and females were significantly below the standard in food energy and iron with the percentage of calories supplied by fat not significantly different than the standard. In secondary schools serving lunches prepared on site, thiamin intake was significantly lower than the standard. However, in secondary schools having preportioned-delivered

Table III-44 Percent of nutrient standards for on-site lunches as consumed, by sex and grade level

	Elementary						Secondary					
Nutrient	MALE	P.[1]	FEMALE	P.	TOTAL[2]	P.	MALE	P.	FEMALE	P.	TOTAL	P.
Food Energy	76.1	.00	74.4	.00	75.6	.00	76.7	.00	88.5	.01	82.0	.00
Protein	196.9	.00	182.1	.00	190.6	.00	196.9	.00	187.4	.00	192.9	.00
Fat	76.8	.00	74.9	.00	76.2	.01	72.6	.00	84.7	.00	78.1	.00
Iron	80.3	.00	73.7	.00	77.5	.00	66.0	.01	59.6	.01	63.2	.01
Calcium	128.5	.00	119.2	.00	124.2	.00	108.9	.10	101.7	-	105.8	-
Phosphorus	142.2	.00	131.5	.00	137.5	.00	131.0	.01	121.4	.01	126.8	.01
Vitamin C	158.8	.00	147.6	.00	153.4	.01	188.9	.01	172.1	.01	180.9	.01
Vitamin A	125.2	.01	121.6	.02	124.0	.01	118.7	-	123.4	-	122.5	-
Riboflavin	154.8	.00	150.4	.00	153.2	.00	143.8	.00	159.2	.00	152.9	.00
Thiamin	81.4	.00	78.6	.00	80.4	.01	81.0	.00	91.2	.11	86.8	.01
Niacin	160.2	.00	154.6	.00	158.6	.01	176.2	.00	197.3	.00	185.8	.00
Fat Constraint	99.4	-	99.0	-	99.3	-	95.3	.10	96.2	-	95.8	.10

[1] Probability

[2] All totals are weighted averages.

Table III-45 Percent of nutrient standards for preportioned-delivered lunches as consumed, by sex and grade level

	Elementary						Secondary					
Nutrient	MALE	P.[1]	FEMALE	P.	TOTAL[2]	P.	MALE	P.	FEMALE	P.	TOTAL	P.
Food Energy	67.5	.00	67.8	.00	67.8	.00	75.7	.00	87.6	.01	81.5	.00
Protein	185.4	.00	176.6	.00	181.4	.00	181.8	.00	177.0	.00	180.5	.00
Fat	66.4	.00	67.2	-	67.0	.01	75.8	.00	87.5	.01	81.5	.00
Iron	69.4	.00	64.9	.00	67.3	.00	62.5	.01	57.8	.01	60.7	.01
Calcium	124.6	.00	121.0	.00	123.1	.00	104.5	-	102.2	-	103.6	-
Phosphorus	137.5	.00	131.7	.00	134.9	.00	125.3	.01	120.2	.01	123.3	.01
Vitamin C	140.0	.01	132.6	.02	136.4	.01	172.7	.01	153.0	.01	165.6	.01
Vitamin A	111.0	-	116.0	.10	113.8	-	98.3	-	108.7	-	104.6	-
Riboflavin	147.5	.00	149.4	.00	148.8	.00	139.9	.00	160.6	.00	151.5	.00
Thiamin	76.2	.00	75.4	.00	76.0	.00	84.0	.00	95.8	-	91.0	-
Niacin	144.2	.00	142.3	.01	143.6	.01	159.6	.00	179.7	.00	169.6	.00
Fat Constraint	97.0	-	97.5	-	97.4	-	100.4	-	101.0	-	100.7	-

[1] Probability

[2] All totals are weighted averages.

lunches, thiamin intake was lower than the standard for males and females but not significantly different from the standard for females. In both school levels, iron and food energy but not thiamin showed greater differences from the standard in preportioned-delivered lunches than on-site lunches as consumed, but the differences were small.

In the above described results, the deficiencies in iron, thiamin, and food energy in lunches as consumed were greater for males than females. It is of interest to compare (see Table III-46) the nutrient levels in these lunches with the nutrient levels in Type A lunches as served and consumed in elementary and secondary schools in the study reported by Jansen, et al (54). The similarity in calculated nutrient levels is striking. The lunches in the present study were slightly higher in vitamin C, and lower in vitamin A and in the percentage of calories supplied by fat, but the overall results are quite similar. In the study of Jansen et al and in the present study, the only nutrient intakes below the nutrient standard were iron, thiamin, and food energy for both grade levels.

ARS (55) conducted a study of lunches in "commodity only" schools in 1974 and reported that lunches often failed to achieve the standard for thiamin, iron, vitamin A, and food energy. The North Carolina State study (29) showed that lunches as served, were inadequate in food energy and a high proportion of the lunches were low in vitamin C and iron relative to the standard of one-third of the RDA. In a similar study conducted by ARS (5, 6, 7), data showed that on the average, lunches as served, achieved or exceeded the standard of one-third of the RDA for all nutrients except iron, magnesium and food energy. A study of lunches served in public high schools in Honolulu, Hawaii in 1970 (19) found generally comparable results; iron and food energy were often less than the standard. The studies of Memphis City Schools and Dade County public schools (11, 12) reported that iron, thiamin, and food energy were most often deficient as served in the Type A lunches. These studies support the findings of this study that iron and thiamin are the nutrients that most often fail to achieve the standard of one-third of the RDA. Although the level of food energy does not reach a level of one-third of the RDA, as stated before, this is little cause for concern since students tend to supplement their food energy requirements from other meals and snacks.

Comparison of Food Consumption with Nutrient Consumption:

As has been discussed previously (p. 78), the amount of food consumed as a proportion of food served varies with the menu item being considered. Typically the consumption, by weight, of foods high in energy such as entrees, dairy products and desserts is higher than consumption of many foods with less energy such as vegetables. For this reason, one might

Table III-46 Comparison of the nutritional quality of lunches as served and as consumed in two studies

	Elementary Schools		Secondary Schools	
	Present Study 1/	Previous Study 2/	Present Study	Previous Study
		Lunches As Served		
Food Energy (Kcal)	726	689	824	873
Protein	29.1	28.9	32.8	36.8
Iron (mg)	3.9	3.8	4.5	5.2
Calcium (mg)	466	448	471	512
Phosphorus (mg)	516	517	571	625
Vitamin C (mg)	28.0	22.6	35.9	28.2
Vitamin A (I.U.)	2292	2640	2395	3405
Riboflavin (mg)	0.76	0.75	0.82	0.88
Thiamin (mg)	0.40	0.37	0.45	0.46
Niacin (meq)	10.1	9.7	11.8	13.0
% Cal from Fat	39.6	42.2	38.8	40.8
		Lunches As Consumed		
Food Energy (Kcal)	589	532	704	717
Protein (g)	23.9	22.7	28.7	31.0
Iron (mg)	3.0	2.7	3.7	4.1
Calcium (mg)	385	361	419	436
Phosphorus (mg)	424	409	501	528
Vitamin C (mg)	20.1	14.3	26.0	19.3
Vitamin A (I.U.)	1465	1578	1714	2018
Riboflavin (mg)	0.63	0.61	0.73	0.76
Thiamin (mg)	0.32	0.28	0.38	0.37
Niacin (meq)	8.2	7.5	10.1	10.9
% Cal from Fat	3913	42.8	39.2	41.7

1/ Present study: Food and Nutrient Consumption in the National School Lunch Program, 1977

2/ Previous study: Jansen, G. R., et al. (51)

expect the percentage consumption of food energy and several nutrients to be higher than the overall consumption of food by weight. This is confirmed as shown by the data presented in Tables III-47 and III-48.

Table III-47 shows nutrient consumption, as percentages of amounts served, for on-site and preportioned-delivered lunches served in elementary and secondary schools. In the elementary schools, consumption of food energy was 84 percent and 79 percent of that served for on-site and preportioned-delivered lunches, compared with corresponding values of 78 percent and 72 percent for overall food consumption. Thus, on the average, food

Table III-47 Nutrients in lunches as consumed and overall weight of food as a percent of the amount served in on-site vs preportioned-delivered lunches, by sex and grade level

Nutrient		Male			Female			All [1]		
		On-Site	Preportioned-Delivered	P. [2]	On-site	Preportioned-Delivered	P.	On-site	Preportioned-Delivered	
Food Energy (kcal)	E	86	81	0.00	80	77	0.04	84	79	0.00
	S	89	86	-	83	81	-	86	84	-
Protein (g)	E	86	83	0.02	80	79	-	84	81	0.07
	S	91	89	-	84	84	-	88	87	-
Fat (g)	E	86	80	0.00	80	77	0.05	84	79	0.00
	S	89	88	-	83	83	-	86	86	-
Iron (mg)	E	84	79	0.00	78	74	0.06	81	77	0.00
	S	87	83	-	79	77	-	83	81	-
Calcium (mg)	E	86	83	0.05	81	80	-	84	82	-
	S	92	91	-	86	88	-	89	90	-
Phosphorus (mg)	E	86	83	0.02	80	79	-	84	81	-
	S	91	89	-	84	85	-	88	88	-
Vitamin C (mg)	E	80	69	0.00	75	65	0.00	78	68	0.00
	S	78	74	-	71	68	-	75	72	-
Vitamin A (I.U.)	E	79	69	0.00	73	65	0.01	76	68	0.00
	S	81	81	-	71	76	-	76	79	-
Riboflavin (mg)	E	87	84	0.05	81	81	-	84	82	-
	S	92	90	-	85	87	-	89	89	-
Thiamin (mg)	E	85	80	0.00	79	76	0.07	82	78	0.00
	S	89	86	-	82	80	-	86	84	-
Niacin (meq)	E	86	82	0.00	80	77	-	84	80	0.01
	S	90	88	-	83	81	-	87	85	-
Overall Weight of food	E							77.8	72.2	0.01
	S							77.7	74.0	0.01

[1] Totals for all students are weighted averages

[2] Probability

Table III-48 Nutrients in lunches as consumed and overall weight of food as a percent of the amount served in elementary vs secondary schools, by sex

Nutrient	Male			Female			All[1]		
	Elem.	Second.	P.[2]	Elem.	Second.	P.	Elem.	Second.	P.
Food Energy (Kcal)	83.4	87.9	0.00	78.6	81.8	0.07	81.3	85.4	0.00
Protein (g)	84.6	90.2	0.00	79.7	83.8	0.02	82.4	87.5	0.00
Fat (g)	83.0	83.7	0.00	78.3	82.7	0.02	81.0	86.2	0.00
Iron (mg)	81.2	85.0	0.03	75.8	77.8	-	78.8	82.0	0.00
Calcium (mg)	84.6	91.3	0.00	80.1	86.7	0.00	82.8	89.4	0.00
Phosphorus (mg)	84.3	90.1	0.00	79.7	84.6	0.01	82.3	87.8	0.00
Vitamin C (mg)	74.5	76.1	-	79.8	69.6	-	72.4	73.4	-
Vitamin A (I.U.)	74.0	80.9	0.01	69.3	73.0	-	71.9	77.7	0.00
Riboflavin (mg)	85.0	91.0	0.00	80.6	85.8	0.00	83.1	88.9	0.00
Thiamin (mg)	82.7	87.6	0.00	77.3	81.0	0.05	80.2	84.9	0.00
Niacin (meq)	83.8	88.9	0.00	78.6	82.0	0.07	81.5	86.0	0.00
Overall Weight of food	78.3	80.2	-	72.9	74.6	-	75.6	77.4	-

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[1] Totals for all students are weighted averages

[2] Probability

energy waste was 25 percent less than the waste of food by weight. In secondary schools, consumption of food energy was 86 percent and 84 percent of that served for on-site and preportioned-delivered lunches, compared with corresponding values of 78 percent and 74 percent for overall food consumption. In this case, the waste of food energy in the lunchroom was close to 40 percent less than was overall food waste by weight.

Table III-47 also shows that in the elementary schools, the intake levels of protein, fat, iron, calcium, phosphorus, riboflavin, thiamin, and niacin, were all also higher than overall food consumption, whereas this was not the case for vitamins A and C. This latter finding is not surprising since it is mainly vegetables that are good sources of these nutrients and are poorly consumed.

The results are similar in the secondary schools. Again, intake levels for vitamins A and C did not exceed overall food consumption. In comparing nutrient intake from on-site lunches with nutrient intake from preportioned-delivered lunches, in only a few cases were there significant differences. As discussed previously, the only nutrients which failed to exceed the nutrient standard were thiamin, iron, and food energy. In elementary schools, intake levels of all of these were slightly but significantly greater with on-site lunches than with preportioned-delivered lunches. In secondary schools, nutrient intake did not differ significantly between the two systems.

In Table III-48, the percentage consumption of food by weight is compared with nutrient intake for males and for females and for all students in elementary and secondary schools. These data are similar to the data shown in Table III-47, except that nutrient intake for males, females and for both sexes together in elementary school are compared with corresponding data for secondary school students. In almost all instances, the percentage of nutrient intake was higher among students in secondary schools than in elementary schools. The only exceptions were vitamin C for both sexes and vitamin A and iron for females. In contrast, for both sexes, food consumed as a percentage of food served did not differ significantly as a function of school level.

Nutrients in Complete Type A Lunches as Compared to All Other Lunches:

The Type A Pattern specifies portion sizes for meat or meat alternate, bread, fruit and vegetables and milk that are required to be served to boys and girls of specified ages. At the time data were collected for this study, butter was a part of the Type A requirements. In the previous tables data from all lunches sampled were included. In actuality, average serving sizes of food selected by students in only eight elementary schools and eight secondary schools completely satisfied the specified serving sizes for all required components of the Type A Pattern. Therefore, lunches in 72 and 16 elementary and secondary schools, respectively, failed to completely satisfy the pattern. There are several possible explanations for lunches that did not satisfy the pattern. First of all, schools that did not serve lunches that satisfied the requirements may have served the required number of components but the portion sizes were smaller than required. This was the most prevalent cause for failing to satisfy the pattern. In some schools, selections were limited - five components were not always served. In these schools, butter was the component most often not included in the lunch.

Table III-49 shows the nutrient levels as served in lunches that satisfied or did not satisfy the Type A Pattern. In the elementary schools, the complete Type A lunches contained significantly higher levels of protein, fat, iron, phosphorus, thiamin, niacin, and food energy than lunches not meeting requirements. In the secondary schools, the complete Type A lunches had significantly higher levels of protein, fat, calcium, phosphorus, riboflavin and food energy. The percentage of calories supplied by fat did not vary significantly in relation to the constraint of 40 percent in lunches at either grade level. Considering the nutrients potentially in shortest supply as compared to the nutrient standard, iron, thiamin, and food energy in the elementary schools were significantly higher in the complete Type A lunch than other lunches that did not meet the criteria. However, in the secondary schools for these three nutrients, the complete Type A lunch was significantly superior to the incomplete Type A lunch for only food energy.

The criteria for meeting the Type A Pattern were very stringent. The requirements specify food components and amounts necessary to provide approximately one-third RDA for all indicator nutrients except fat and food energy. Realizing this rigidity, the nutrient levels in lunches as served and as consumed in elementary and secondary schools were calculated for lunches that met 100 percent of all specified components by weight for the Type A Pattern and compared with lunches that met only 95 percent of all specified components by weight. Data showed that, generally, as the constraint in meeting the pattern was relaxed, the number of schools that satisfied the less stringent requirements increased. However, under the less stringent requirements, the nutritional integrity of the pattern is somewhat weakened. It is significant that the lunches that completely met the portion sizes specified in the Type A Pattern were superior from a nutritional standpoint as compared to lunches that did not meet the Type A requirements. This is not an unexpected finding, since one would expect higher levels of nutrients including food energy with greater portion sizes. However, it does strongly reinforce the principle that proper attention to portion sizes in the Type A Pattern will make a contribution toward improving the nutritional quality of school lunches, not only as served, but also as consumed. Furthermore, it must be remembered that the Type A Pattern is designed to include foods of specific kinds and amounts which will achieve a goal of approximately one-third of the RDA for children of various ages.

Table III-49 Nutrients in lunches that met or did not meet the requirements for the Type A Pattern

	Elementary Schools		
	Met Type A (n=8)	Did Not Meet Type A (n=72)	P. [1]
Food Energy (Kcal)	840	714	0.00
Protein (g)	33.1	28.7	0.00
Fat (g)	40.8	31.4	0.00
Iron (mg)	4.5	3.8	0.03
Calcium (mg)	499	462	-
Phosphorus (mg)	572	510	0.02
Vitamin C (mg)	33.9	27.3	-
Vitamin A (I.U.)	1803	2346	-
Riboflavin (mg)	0.80	0.76	-
Thiamin (mg)	0.46	0.39	0.02
Niacin (meq)	11.8	10.0	0.02
% Cal from Fat	42.2	39.3	-

	Secondary Schools		
	Met Type A (n=8)	Did Not Meet Type A (n=72)	P. [1]
Food Energy (Kcal)	930	770	0.00
Protein (g)	36.4	31.0	0.01
Fat (g)	40.5	33.0	0.00
Iron (mg)	4.8	4.3	-
Calcium (mg)	519	446	0.01
Phosphorus	631	540	0.01
Vitamin C (mg)	35.0	36.4	-
Vitamin A (I.U.)	2968	2108	-
Riboflavin (mg)	0.90	0.78	0.00
Thiamin (mg)	0.48	0.43	-
Niacin (meq)	12.7	11.3	-
% Cal from Fat	39.4	38.4	-

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[1] Probability

5. Conclusions

(a) Participation in the school lunch program was significantly greater at the elementary level than at the secondary level. Schools which served lunches prepared on site had significantly higher participation than did schools serving preportioned-delivered lunches.

(b) Participation in the lunch price categories differed according to the foodservice system in elementary schools. Schools serving preportioned-delivered lunches had the highest participation in the free-lunch category; in schools with lunches prepared on site, participation was highest in the full-price category. In secondary schools there were no real differences between foodservice systems.

(c) The price charged to students for full- and reduced-price lunches did not differ by the grade levels. The full price for preportioned-delivered lunches was only slightly higher than for lunches prepared on site.

(d) A majority of the preportioned-delivered lunches were received from a central kitchen within the school system only.

(e) Secondary students consumed most foods in the menu item categories to a greater extent than elementary students. The exceptions were vegetables and fruits.

(f) Lunches prepared on site had less plate waste and a greater percent consumption than preportioned-delivered lunches.

(g) Males generally ate a larger portion of their lunches than females.

(h) The serving size influenced both plate waste and percent consumption. When serving size was considered in an analysis of covariance, grade level differences were less significant and foodservice system and sex were the factors which accounted for differences in waste and percent consumed.

(i) Raw and cooked vegetables had the lowest percent consumption (and highest plate waste). In both grade levels, for both foodservice systems and for both sexes, milk had the highest percent consumption and lowest amount of waste.

(j) Foodservice systems had a significant effect on percent consumption of raw vegetables, cooked vegetables, potatoes/pasta, fruit, bread and miscellaneous items. For these food categories consumption was significantly higher in the schools serving lunches prepared on site than in schools serving preportioned-delivered lunches. When data were adjusted for serving size, the results remained the same. However, dessert was then affected by the foodservice--again, consumption was higher in the schools serving lunches prepared on site.

(k) Students consumed more raw than cooked vegetables.

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(l) Lunches prepared on site contained significantly higher levels of iron and food energy than lunches preportioned and delivered in elementary schools. The type of foodservice system did not influence the level of any other nutrients. In secondary schools there were no significant differences in the nutrients or food energy served in the two foodservice systems.

(m) Lunches prepared on site in elementary schools contained a significantly lower level of food energy when compared to the standard of one-third RDA. Iron and thiamin were also low but not significantly lower than the standard. Preportioned-delivered lunches contained significantly lower iron and food energy.

(n) In secondary schools with on-site lunches, iron was significantly lower than the standard for males and females; thiamin, and food energy were significantly lower than the standard for males.

(o) All other nutrients (except fat) were significantly higher than the standard for both grade levels and both foodservice systems. In lunches for both grade levels and for both foodservice systems, the percentage of calories supplied by fat did not differ significantly from the constraint of 40 percent.

(p) In elementary schools serving lunches prepared on-site, students had slightly higher intake levels of protein, iron, thiamin, niacin, and food energy than students in schools where lunches were delivered preportioned. When compared to preportioned-delivered lunches, on-site secondary school lunches as consumed were significantly higher only in protein and niacin.

(q) When the nutrient levels in lunches as consumed were compared with the nutrient standard, iron and thiamin (except females in secondary schools with preportioned-delivered lunches) and food energy were significantly deficient for both school levels, both sexes and both foodservice systems. For all other nutrients, intake levels were above or close to the standard under all conditions measured.

(r) Iron, thiamin and food energy were the nutrients most often deficient; however, on-site lunches as consumed in elementary schools provided levels of **these** nutrients closer to the standard than preportioned-delivered lunches. The differences were not large. Results were similar for food energy and iron in secondary school lunches.

(s) Food consumption was higher for foods high in energy such as entrees, dairy products and desserts than for foods low in energy such as vegetables; therefore, the loss of food energy and most nutrients was less than the loss of food by weight.

(t) In elementary schools, lunches as served, that completely satisfied the serving size requirements of all food components specified in the Type A Pattern had significantly higher levels of protein, iron, phosphorus, thiamin, niacin and food energy than did lunches that failed to satisfy these serving size requirements. Results observed for secondary school lunches as served showed significantly higher levels of protein, calcium, phosphorous, riboflavin, and food energy. Proper attention to portion sizes could improve the nutritional quality of school lunches.

IV. Approaches to Minimizing Plate Waste in Child Nutrition Programs

Recent universal concern about world food supplies, food shortages and conservation of resources has generated widespread public concern about food waste. The Department, being concerned about food waste in its programs, has initiated several changes in the Child Nutrition Program to minimize plate waste. The changes have ranged from a congressional amendment of the National School Lunch Act to reviewing the Type A Pattern and implementing some of the recommendations. In addition, a new lunch pattern has been proposed and increased emphasis has been placed on training and nutrition education for school foodservice personnel, cooperators and participants. Approaches to minimizing plate waste are discussed below.

A. Offer Versus Serve Provision

In order to minimize food waste in the National School Lunch Program, Congress included in Public Law 94-105 (enacted October 7, 1975) a provision which directed the Secretary of Agriculture to establish, in cooperation with State educational agencies, "administrative procedures, which shall include local educational agency and student participation, designed to diminish waste of foods which are served by schools participating in the school lunch program under this Act without endangering the nutritional integrity of the lunches served by such schools." This 1975 amendment to the National School Lunch Act also provides that:

> "students in senior high schools which participate in the school lunch program under this Act shall not be required to accept offered foods which they do not intend to consume, and any such failure to accept offered foods shall not affect the full charge to the student for a lunch meeting the requirements of this subsection or the amount of payments made under this Act to any such school for such a lunch."

Effective June 3, 1976 the National School Lunch Program regulations were amended by Amendment 23 to effect this Congressional mandate. The regulations allow senior high school students the latitude of choice required by law, while striving to maintain a degree of the nutritional integrity of the Type A lunch. This amendment states that senior high school students shall be offered and may take the complete Type A lunch, however, students must choose a minimum of three of the five food items contained within the four food components of the Type A lunch. This provision is commonly known as the "offer versus serve" provision. Table IV-1 illustrates what is meant by the "five food items contained within the four food components of the Type A lunch."

Table IV-1 Five food items contained within the four food components of the Type A Lunch

Components	Food Items	Sample Type A Menu
1. Meat/Meat Alternate	1. Meat/Meat Alternate	1. Oven-Fried Chicken
2. Vegetables and Fruits - Two or More	2. Vegetable [1] 3. Fruit [1]	2. Mashed Potatoes 3. Seasoned Green Beans
3. Bread	4. Bread	4. Roll
4. Milk	5. Milk	5. Milk

[1] May be combination of vegetables and fruits or two vegetables (as shown in menu) or two fruits.

The "offer versus serve" provision, which is designed to help reduce food waste, recognized that students who are of a high school level have a special independent nature and ability to exercise discretion in their choices of foods. School food service managers, supervisors and school food authorities are charged with the task of providing senior high school students lunches that they will not only accept but will want to consume. Such a task requires imagination, expertise, and hard work. The manager must assume a responsibility for offering all the food items in the Type A lunch in such a manner that the students will be motivated to consume all or almost all of the food they accept. Additionally, the manager must develop a management and record keeping system that will allow for forecasting the amount of food to be prepared, thereby ensuring the minimum waste of food. Forecasting food needs based on records of past acceptability of offered food is necessary to ensure that foods are not wasted on the students' plates or as a result of overproduction.

The same Amendment (Amendment 23) also deleted butter/fortified margarine as a requirement from the Type A Pattern to bring the pattern into closer conformity with current nutrition knowledge indicating possible undesirable effects of excess fat in the diet. This provision was also implemented in June 1976.

In an effort to further reduce unnecessary plate waste the Department recently published in the Federal Register a final regulation that extends the "offer versus serve" provision to students in junior high schools and middle schools (June 16, 1978). The rule permits these students to choose less than the complete Type A lunch when approved by local School Food Authorities. If local School Food Authorities permit, these students will have the same option to refuse part of the Type A lunch that the regulations presently allow senior high school students.

B. Proposed Revisions in Lunch Pattern

Since the inception of the National School Lunch Act in 1946, the Type A Pattern has helped assure that lunches served in the school lunch program are nutritious. This pattern is reviewed periodically and revised as necessary to take into account new information about the nutritional needs of children (as RDA are revised), students' consumption and eating patterns, food preferences, and problems encountered in the use of such meal patterns in the school lunch program. The Food and Nutrition Service has recently cooperated with Science and Education Administration in conducting such a review taking into account the 1974 revision of the RDA. In addition to evaluating the pattern in terms of the RDA, the Food and Nutrition Service (FNS) and Science and Education Administration (SEA) also considered other factors during the review such as:

(1) effectiveness of the pattern as used,
(2) impact of cost of food in relation to nutrient goal,
(3) interpretation of pattern at local level,
(4) concerns of State agencies and local school districts,
(5) actual consumption and, in turn, nutrient contributions of lunch as served and consumed.

This review led to the development of proposed revisions in the lunch pattern which were published in the Federal Register (September 7, 1977). Comments were received and interim regulations were published in the Federal Register on August 22, 1978.

In an effort to reduce plate waste while maintaining the nutritional goal of the lunch program, revisions have been proposed which define minimum portion sizes for children of varying age groups, thereby allowing significantly smaller portion sizes for elementary students while more accurately meeting the nutritional needs of children of all ages. Additionally, a greater number of conventional foods such as enriched or whole-grain rice, macaroni, noodles and other pasta products are to be incorporated into the lunch pattern, and the required amounts of some food components will be changed.

The nutritional goals of the proposed lunch patterns are based on the 1974 RDA for children of different ages. In developing these patterns, consideration was given to amounts of food energy and all nutrients for which RDA have been established and adequate reliable food composition data were available. Since the school lunch pattern allows for a variety of foods that will meet goals for the nutrients included in the RDA, it is assumed that the pattern will also provide sufficient amounts of the many other nutrients for which no RDA are established or food composition data are not available.

The nutritional goal of the National School Lunch Program is to furnish one-third of the RDA for school children.

Approximately 22 percent of the RDA for energy will be provided when lunches meet minimum requirements of the proposed patterns. Lunches which furnish less food energy (Kilocalories) than one-third of the RDA are believed to be appropriate for the National School Lunch Program. As has been stated earlier, many children eat other meals and snacks which may well provide more than two-thirds of their daily needs (see page 86). Again, lunches providing high levels of food energy will contribute to many children overeating or discarding some food served to them.

The level of fat in the proposed patterns is lower than that found in diets of many individuals and of that indicated by studies of school lunch composition, conducted by USDA and other researchers (8, 11, 12, 53). The approximate percentage of food energy provided by fat in the proposed new lunch patterns ranges for various age groups between 34 and 37 percent when whole milk is served; 30 and 33 percent when lowfat milk is served; and 24 and 29 percent when skim milk is served. To keep the amount of fat in the lunch at a moderate level while maintaining a degree of individual choice, proposed regulations specify that unflavored fluid lowfat milk, skim milk, or buttermilk, must be available to students. Such milks may be offered as a choice item along with other types of fluid milk or as a single item to meet the milk component of the lunch requirements.

The 1974 RDA specified nine age-sex groups of children and young adults. To provide realistic age groups of preschool and school-age children and to reduce the number of groups for practical and administrative purposes, the RDA for some age-sex groups have been combined. This reduced the number of groups while providing realistic differences in the required quantities of some food components. The proposed lunch patterns provide approximately one-third of the RDA for five groups in order to more accurately meet the nutritional needs of all students. The lunch patterns are given in Table IV-2. The table shows the minimum amounts of foods, listed by food components, to serve students of various age/grade groups. The nutrient goals specified by age groups are presented in Table IV-3. These proposed patterns more realistically allow for smaller portion sizes for younger children than present guidelines (Table IV-1), and eliminate the impractical ranges which had been used for older children.

Attempts were made to incorporate some other foods into the basic pattern wherever nutritionally sound. A major change between the present Type A Pattern and the proposed pattern is the inclusion of rice and macaroni or noodle products in the bread alternate group. Present regulations recommend "other foods" such as rice, macaroni, etc. to be included to complete lunches, to help improve acceptability, and to provide additional food energy and other nutrients. The need for nutrients provided by bread resulted in a slight increase in quantities of bread/bread alternates required. However, in reality there is very little change in quantity as required amounts for these foods are on a weekly rather than a daily basis.

Table IV-2 Interim school lunch pattern requirements

Food Components	Preschool children		Elementary School students		Secondary School students
	Group I (1 and 2 yr)	Group II (3 and 4 yr)	Group III-Grades K-3 (5, 6, 7, and 8 yr)	Group IV-Grades 4-6 (9, 10, and 11 yr)	Group V-Grades 7-12 (12 yr and over)
Meat and Meat Alternates[1] Meat-a serving (edible portion as served) of cooked lean meat, poultry, or fish, or meat alternates (ounces equivalent).[2] The following meat alternates may be used alone or in combination to meet the meat/meat alternate requirement:[3] Cheese (1 oz. equals 1 oz of cooked lean meat). Eggs (1 large egg equals 1 oz of cooked lean meat)cook dry beans or peas (½ cup equals 1 oz cooked lean meat).[4] Peanut Butter (2 tablespoons equal 1 oz cooked lean meat).	1	1 1/8	1 1/8	2	3
Vegetables and Fruits 2 or more servings consisting of vegetables or fruits or both. A serving of full strength vegetable or fruit juice can be counted to meet not more than 1/3 of the total requirement (cup).	1/2	1/2	1/2	3/4	3/4

Table IV-2 Interim school lunch pattern requirements continued

Food Components	Preschool children		Elementary School students		Secondary School students
	Group I (1 and 2 yr)	Group II (3 and 4 yr)	Group III-Grades K-3 (5, 6, 7, and 8 yr)	Group IV-Grades 4-6 (9, 10, and 11 yr)	Group V-Grades 7-12 (12 yr and over)
Bread and Bread Alternates[5] A serving (1 slice) of enriched or biscuits, rolls, muffins, etc., made or flour;[6] or a serving (1/2 cup) of cooked enriched or whole-grain rice, macaroni, noodles, and other pasta products[7] (slices or alternate per week).	5	8	8	8	10
Milk, Fluid[8] 2 types of milk must be offered, one of which must be unflavored fluid lowfat milk, or skim milk, or buttermilk.	3/4 cup	3/4 cup	1/2 pint	1/2 pint	1/2 pint

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[1] It is recommended that in schools not offering a choice of meat/meat alternates each day, no one form of meat (ground, sliced, pieces, etc.) or meat alternate be served more than 3 times per week. Meat and meat alternates must be served in a main dish, or in a main dish and one other menu item.

[2] Equivalents will be determined and published in guidance materials by FNS/USDA.

[3] When it is determined that the serving size of a meat alternate is excessive, the particular meat alternate shall be reduced and supplemented with an additional meat/meat alternate to meet the full requirement.

[4] Cooked dry beans or dry peas may be used as the meat alternate or as part of the vegetable/fruit component, but not as both food components in the same meal.

[5] One-half or more slices of bread or an equivalent amount of bread alternate must be served with each lunch with the total requirement being served during a 5-day period. Schools serving lunch 6 or 7 days per week should increase this specified quantity for the 5-day period by approximately 20 percent (1/5) for each additional day.

[6] Bread alternates and serving sizes will be published in guidance materials by FNS/USDA.

[7] Enriched macaroni products with fortified protein as defined in appendix A, March 1974, may be used as part of a meat alternate or as a bread alternate, but not as both food components in the same meal.

[8] One-half pint of milk may be used for all age/grade groups if the lesser specified amounts are determined by the school food authority to be impractical.

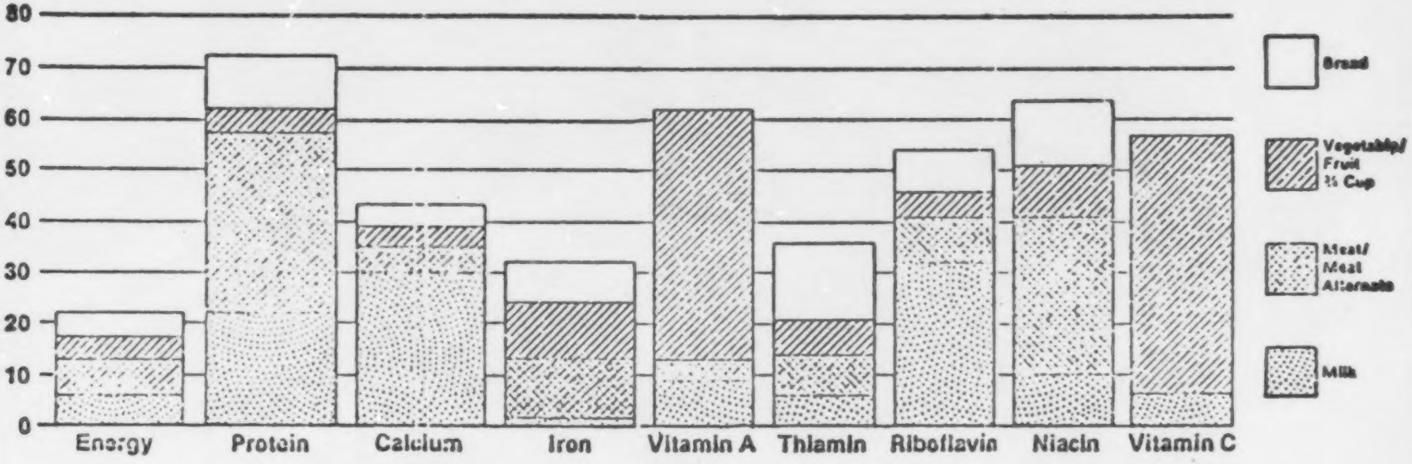
Table IV-3 Nutrient goal in the proposed lunch patterns based on Recommended Dietary Allowances (1974) adjusted for five age categories

	Ages				
Nutrients	1-2	3-5	6-8	9-11	12-18
Food Energy (Kcal)	433.00	533.00	700.00	833.00	867.00
Protein (g)	8.00	9.00	11.00	13.00	16.00
Calcium (mg)	267.00	267.00	267.00	317.00	400.00
Iron (mg)	5.00	4.00	3.30	4.30	6.00
Vitamin A (IU)	667.00	783.00	983.00	1250.00	1500.00
Thiamin (mg)	.23	.26	.36	.40	.43
Riboflavin (mg)	.26	.33	.40	.43	.50
Niacin (meq)	3.00	3.60	4.60	5.30	5.60
Ascorbic Acid (mg)	13.00	13.00	13.00	13.00	15.00

For instance, when sandwiches are served, credit could be given for two servings of bread under the proposed regulations rather than only one serving as previously allowed.

In order to evaluate the nutritional integrity of the proposed pattern, the nutritive value of each food component was calculated based on the frequency of service of meat/meat alternates, and fruits and vegetables in school lunches served to 60 test groups over a four-week period. The nutritive value of whole milk was used to represent the milk requirement, and the nutritive value of white enriched bread was used to represent the bread requirement. The nutritive value of the lunch pattern for the 9- to 11-year-old child can be seen in Figure IV-I. Food energy and iron are the only nutrients not exceeding the goal. Food energy has deliberately not been forced to meet one-third of the RDA for reasons explained earlier. Thirty-two percent of

Figure IV-1 Percent of the Recommended Dietary Allowances (1974) provided by components of the proposed school lunch pattern for children 9 to 11 years of age



the RDA for iron is furnished by the proposed pattern. While slightly under the goal of 33-1/3 percent, the pattern furnished 8 mg. iron per 1,000 calories -- well over 6 mg iron per 1,000 calories which is the amount expected from a varied, well-balanced diet as specified by the Food and Nutrition Board of the National Academy of Sciences, National Research Council. All other nutrients meet or exceed the nutrient goal. The Department is aware of concern over the requirements of larger amounts of meat to furnish protein. However, these amounts are needed in order to furnish nutrients other than protein as shown in Tables IV-1 and IV-2.

It is anticipated that these proposed changes in lunch patterns will decrease amounts of plate waste. Data in the Food and Nutrient Consumption Study have shown that younger children have higher plate waste. Accordingly, these patterns realistically reduce amounts of food for children in the lower age bracket. While amounts for older children are greater than required by the Type A Pattern, they are similar to previous guidelines for amounts to serve secondary school children, and are necessary to meet the nutritional goal.

The regulations also require student involvement and education. Student education and student-community involvement in the programs have been found, in many instances, to be keys that have successfully led to better student acceptability of foods, higher overall participation levels, and increased nutrition awareness, all of which can have a positive impact upon student health and well-being. Therefore, the proposed regulations encourage School Food Authorities to utilize the school food service program to teach students about good nutrition practices. School Food Authorities are also required to involve students in the program through activities such as menu planning, enhancement of the foodservice environment, program promotion and related student-community support activities, and also encourage the involvement of parents, teachers, and community in these activities.

In order to effectively evaluate the impact of the numerous proposed changes on the program, the Department is conducting four studies on the interim NSLP regulations. Also, two pilot projects mandated by Section 10 of P.L. 95-166 are being conducted. These studies and projects include:

STUDY 1 - DETERMINATION OF THE EFFECTS OF CHANGES IN THE LUNCH MEAL PATTERN REQUIREMENTS

STUDY 2 - DEMONSTRATION PROJECTS FOR INVOLVING STUDENTS, FACULTY AND PARENTS IN THE SCHOOL LUNCH PROGRAM

STUDY 3 - DEMONSTRATION PROJECTS FOR CONTROLLING SUGAR, FAT AND SALT IN SCHOOL LUNCHES

STUDY 4 - DEMONSTRATION PROJECTS FOR PROVIDING ONE-THIRD OF THE RECOMMENDED DIETARY ALLOWANCES (RDA) FOR FOOD ENERGY IN SCHOOL LUNCHES

STUDY 5 - PILOT PROJECTS FOR USING EXTENSION SERVICE SPECIALISTS IN

TRAINING SCHOOL FOODSERVICE MANAGERS

STUDY 6 - PILOT PROJECTS TO DETERMINE THE NUTRITIONAL, FOOD QUALITY, PLATE WASTE AND FOOD COST IMPACT OF USING CASH IN LIEU OF COMMODITIES IN SCHOOL LUNCHES

The data have been collected and are being analyzed. The information will be used to assist the Department in finalizing regulations for the NSLP that are administratively feasible while providing acceptable lunches to students that meet the nutritional goal of the program. Information obtained through this evaluation and demonstration projects will also be used by FNS to assist State and local school foodservice personnel in implementing the various changes presented in the NSLP regulations.

C. Regulations Concerning the Sale of Foods in Competition with School Lunch

The Department announced in the Federal Register on December 15, 1978 the withdrawal of the April 25, 1978 proposed regulation for competitive foods and plans for three public meetings to discuss the sale of candy and other foods in competition with lunches in the NSLP. The public meetings addressed questions raised by the comments received on the Department's earlier proposal to ban the sale of candy, soda water, frozen desserts, and chewing gum in schools until the end of the lunch period. The discussions were limited to nutrition education, health, eating habits and local considerations. Based on comments given at the public meetings, the Department has issued new proposed regulations which are expected to become final by January 1, 1980. Congress has directed the Secretary to regulate the sale in schools of competitive foods of little nutritional value.

D. Food Preparation in the Child Nutrition Programs

The Department has long encouraged on-site preparation of meals in schools. In the National School Lunch Act and Child Nutrition Amendment of 1977, Section 13(a) reads "To the maximum extent feasible, ... any food service under the program shall use meals prepared at the facilities of the service institution...." In addition, the legislation puts a priority on federal foodservice equipment funds for (a) schools without facilities such as those schools not currently participating in the program, (b) schools without facilities to prepare and cook or receive hot meals, and (c) schools having equipment that is obsolete or impaired to the extent that it endangers the continuation of an adequate food service program or the ability to prepare hot meals.

On October 27, 1978, a proposed rule appeared in the Federal Register that amends the Nonfood Assistance Program regulations to change the title of the program to "Food Service Equipment Assistance Program" and to bring the regulations into conformance with Public Law 95-166. In addition to priority fund allocations, the regulations also permit schools to contract with public and nonprofit private institutions and thereby utilize food service equipment assistance in order to prepare meals for children attending such schools which are unable to provide meal service. The schools would retain title to the equipment.

E. Training and Nutrition Education for School Foodservice Personnel, Cooperators and Participants

Two interrelated factors which also have an impact on food acceptability (and thus can cause reduction in plate waste) in Child Nutrition Programs can be identified as the skill of the foodservice workers who plan, prepare, and serve meals to students participating in the programs, and the knowledge and attitudes of participating students toward foods, nutrition and health. A discussion of U.S. Department of Agriculture efforts to influence these factors follows.

1. Training School Foodservice Personnel

The success of the NSLP in achieving its objective of serving nutritionally adequate, attractive lunches which school children will enjoy and consume depends in large part on the abilities of trained personnel responsible for the day-to-day activities of planning, preparing and serving the food. In order to assist in the training of these foodservice workers, the Department has provided materials and funds for training which are disseminated to State agencies and local school districts which carry out the program. Training efforts in the Child Nutrition Programs traditionally have been a joint Federal, State and local effort.

Since the enactment of legislation for school foodservice programs in 1946, USDA has developed and distributed basic program aids to assist school foodservice personnel in planning, preparing and serving meals that meet the meal pattern requirements of the program and in understanding the relationship of the meals to the dietary needs of children. These program aids provided important information on good menu planning and food purchasing techniques to meet program requirements and on proper food preparation and foodservice management for an efficient and effective school foodservice program.

A portion of Child Nutrition Programs federal operating funds is used to maintain the Food and Nutrition Information Center (FNIC) at the National Agricultural Library (NAL). The center is designed to collect and disseminate information on school foodservice training and nutrition education. FNIC serves as a central repository of instructional materials particularly relating to (a) training and instruction of school foodservice personnel; (b) operational management of volume feeding services, specifically as carried out under authority of the Child Nutrition Programs; and (c) nutrition education, management and training, and research specifically pertinent to the Child Nutrition Programs.

In 1970 the National School Lunch Act was amended and Section 6(a)(3) authorized the Secretary to use funds to supplement the nutritional benefits of the Child Nutrition Programs. These activities are accomplished through grants to the States and through cooperative agreements or other contractual arrangements with States, or contracts with nonprofit institutions, universities, or private industry. A portion of these funds is for the nutritional training and education of workers in the Child Nutrition Programs.

The rapid growth of the Child Nutrition Programs continues to increase the demand for efficiencies in management and for professionally trained school foodservice personnel. Among the major school foodservice challenges to be achieved are to:

- Increase menu variety and selectivity,
- Broaden the participant's selection of foods,
- Increase acceptance of foods among students,
- Increase food and beverage consumption and thereby reduce plate waste, and
- Increase program participation among the students.

Well-trained personnel--workers, managers and staff--are required to accomplish these challenges. Planned, formalized training programs and effective instructional materials and methods are needed in order to properly train these personnel. The National Advisory Council on Child Nutrition has expressed continued interest in increasing student participation in the Child Nutrition Programs. In particular, the council is interested in providing support materials for upgrading the training and education of school foodservice personnel to achieve program goals in terms of reaching more children with nutritious meals which they will consume.

In 1975 the Department contracted for a study to develop a profile for school foodservice personnel (56). Factors assessed included professional/educational background, the type, amount and quality of in-service training completed and the need for additional training. Three major job work categories were defined: (a) manager--the person who devotes the major portion of time to supervising the foodservice and program administration, (b) skilled worker--the person who primarily performs the duties of cook and/or baker, and (c) semi-skilled worker--the person who primarily performs duties other than administration, cooking and/or baking, but at times assists in those duties.

Data from the study indicated that State school lunch offices offered 30 percent of the available training courses; local school districts, 29 percent; colleges and universities, 24 percent; and USDA regional offices, 11 percent. Only 30 percent of the respondents reported completing formal training in the past 10 years. The five courses most often taken by participants in the past five years were, in order of frequency, Sanitation and Safety, Use and Care of Equipment, Quantity Food Preparation, Nutrition and Menu Planning. The reasons given by respondents for having taken training was to improve job performance.

When asked what courses respondents would like to take, the four most commonly mentioned were Nutrition, Quantity Food Preparation, Menu Planning, and Sanitation. Suggestions for improving existing training courses included: easier access to training site, greater frequency of classes, better quality of courses and more subject variety. Results of the study provided a framework and guidance for developing future training programs.

To address some of these concerns the Department has embarked on a series of training projects to update the knowledge and skills of foodservice personnel (57). These projects are discussed below.

- A project titled "Food for Youth," is a TV series of ten 30-minute color videotapes for teaching the subject of nutrition and foodservice to school foodservice employees. It is accompanied by a study guide containing discussion questions and quizzes. Together the educational package provides a structured televised course in nutrition which can be offered to the local workers through films or the Public Television Library.

- An independent study program for school foodservice managers includes eight complete courses, each covering a subject of foodservice management (e.g., nutrition education, purchasing, sanitation). Each course contains a study guide, audiocassette tapes and reference materials. Such a program can reach individuals in remote areas who do not have access to more formal or structured training programs such as workshops, classes at community colleges and the like. The series has been administered on a pilot basis to approximately 240 participants.

- A set of training manuals has been developed for use in workshops and classroom teaching situations. Basic reference information in all areas of school foodservice management for State and local school foodservice personnel is provided. The manuals cover the basic elements of school foodservice and guidance on planning, implementing and evaluating training programs for school foodservice personnel.

Additional projects included the development of competency based training necessary for school foodservice personnel and teachers to work together as a team in nutrition education. One State recently completed a modular certification training program offered through a mobile van classroom equipped for quantity food preparation. This van will take the instructional program to school districts throughout the State. Another State has developed a set of written materials supplemented by audiocassette tapes and worksheets designed for use as self-paced learning tools for training school foodservice personnel.

Recently eight State agencies were provided grants for planning, developing and implementing programs and materials designed for training school foodservice personnel. It is anticipated that the training plans, instructional methods and materials developed through these grants will be useful to other States throughout the nation in their continuing efforts to offer opportunities for upgrading management and employee knowledge and skills.

2. Nutrition Education

For the past thirty years it has been recognized that school nutrition programs can function as a part of an educational program to teach children and youth the basis of nutrition (58). Studies have indicated that individuals who are uninformed or misinformed with respect to reliable nutrition information cannot be expected to take positive action in making wise food choices. However, there is no guarantee that individuals who possess accurate up-to-date knowledge of nutrition will behave or act in accord with this knowledge unless this information is integrated into that individual's lifestyle and is made meaningful to the individual.

Until 1970, nutrition education activities carried out in conjunction with the Child Nutrition Programs were basically developed, funded and implemented at the local level. In 1970 the Congress, recognizing the need for additional nutrition education activities, passed Public Law 91-248 amending the National School Lunch Act and added Section 6(a)(3). This legislation provided USDA with the authority to make funds available to States for nutrition education for school foodservice personnel, teachers, students, school administrators, and other cooperators.

The Department has carried out a number of projects to implement nutrition education in selected States, to determine the extent of nutrition education activities and to identify the effect of nutrition education on consumption of meals at school.

In 1974 the Education Commission of the States (located in Denver, Colorado) awarded a contract to provide FNS with documented data on policies, procedures, practices, and opinions relating to nutrition education at the Federal, State and local school district level for three time frames - past, present, and future (57). Fifty-one State Education Agencies (SEA) and approximately 1,400 local educational agencies were surveyed. The study revealed that 31 of the SEA's reported either having or planning to have offices responsible for nutrition education. Local education agencies ranked nutrition education third in priority in relation to seven other health subjects and over 42 percent of the local educational agencies (LEA) surveyed sponsored non-mandated nutrition education activities. These facts attest to the support of nutrition education programs at the State and local level.

FNS has encouraged the utilization of school foodservice as a learning laboratory to provide educational activities and resources which can effectively supplement and reinforce classroom programs and curricula. With a team effort by teachers and foodservice managers, the foundation is developed to establish good eating habits through nutrition education, thus increasing food acceptance. Nutrition education projects funded by USDA have included regional nutrition education seminars, a program to hire State nutrition education specialists, and a project to implement a team approach to nutrition education involving teachers and school foodservice personnel. These efforts are jointly shared by Federally funded activities and State and local commitments to nutrition education. The Federally funded activities provide an impetus to the States to provide nutrition education in the classroom integrated with the eating experience.

Eight States received grants for a nutrition education specialist at the State level to coordinate nutrition education activities. These grants provided seed money in these States to initiate a nutrition education program coordinated with the school foodservices. Currently, five of these States continue to employ a nutrition education specialist at the State level to implement the nutrition education curriculum materials developed under these grants.

Four nutrition education projects have attempted to measure the effect nutrition education has on plate waste (57). In California, teachers, parents and nutrition specialists participated in a nutrition instruction program for primary level students. Comparison of pretest and post-test data indicated an increase in consumption of the foods given special emphasis. A nutrition education project in selected Nebraska schools was conducted to assess the effectiveness of nutrition education programs in relation to their influences on participation, food acceptance, and plate waste by students participating in the Child Nutrition Programs. Actual consumption increased by 20 percent or more for seven different food items. Montana participated in a demonstration project implementing a comprehensive elementary nutrition education program in conjunction with school foodservice programs and integrated with other curriculum areas. A positive change in pupils' attitudes towards food through nutrition education, was demonstrated through a decrease in plate waste. West Virginia Department of Education in cooperation with a local school system developed and implemented a sequential nutrition education program for elementary children, grades kindergarten through six. Plate waste at the end of the nutrition education program was lower among the students in the experimental schools than in the control schools with the exception of one test food--milk.

In 1975, a contract was awarded to evaluate the effect and importance of methods, materials, content, and personnel on (a) students' knowledge of nutrition, (b) students' attitudes/opinions about food, nutrition, health, meals away from school and meals at school, (c) students' food selection practices at school and away from school, (d) participation in Child Nutrition Programs, and (e) acceptance and consumption of meals served at school (57). A nutrition curriculum was implemented in five school districts involving: 30 schools, 6,268 students, 183 teachers, and 30 school foodservice managers. During the field test period of three months, knowledge tests and attitudinal questionnaires were administered to control and experimental subjects as a pretest, post-test, and 30 day post-test. All students in the study gained in nutrition knowledge; the greatest positive change in food attitudes was in grades K-1 and 2-3. With the methodology used, the contractor did not observe any measurable impacts on plate waste.

The Department is expanding its efforts in nutrition education for the Child Nutrition Programs. Section 18 of the Child Nutrition Act, 1966, as amended, authorizes the Secretary to make cash grants to State Educational Agencies for the purpose of conducting experimental or demonstration projects to teach school children the nutritional value of foods and the relationship of nutrition to human health. The Department requested and received appropriation of $1,000,000.00 in FY '78. Plans for utilizing a portion of these funds for grants to States was announced in the Federal Register notice dated July 5, 1978. Through this notice the Department solicited grant proposals for Nutrition Education demonstration projects that would have a positive impact on food acceptance of children participating in the Child Nutrition Programs. Three State Educational Agencies (Arizona, Minnesota, Tennessee) were awarded grants on September 25, 1978.

The major objective of the Arizona project is to develop innovative approaches to coordinate the school foodservice programs and the school curricula into an overall school-wide approach to nutrition education. The Minnesota SPEAC Nutrition Education Program (students, parents, educators, administrators, and children) will develop a model to integrate the Child Care Food Program (CCFP) into the educational curriculum and activities of child care programs. The purpose of the Tennessee Project is to develop a nutrition education program for mentally retarded and developmentally disabled children and to determine its effectiveness on the acceptance of foods offered in the school feeding program.

Section 19 of the Child Nutrition Act of 1966, as amended by Public Law 95-166, authorized the Secretary to formulate and carry out a nutrition information and education program through a system of grants to State Agencies to provide for (1) nutritional training of educational and foodservice personnel, (2) foodservice management training of school foodservice personnel, and (3) nutrition education activities in schools and child care institutions.

Specifically, these nutrition education programs shall include, but not be limited to, (a) instructing students with regard to the nutritional value of foods and the relationship between food and health, (b) training school foodservice personnel in the principles and practices of foodservice management, (c) instructing teachers in sound principles of nutrition education, and (d) developing and using classroom materials and curricula.

On May 15, 1979, the Department issued final regulations implementing the Nutrition Education and Training Program authorized by Section 19 of the Child Nutrition Act of 1966, as amended. These regulations relate to the application for participation by State Educational Agencies, the appointment of and funding for a nutrition education specialist to serve as a State Coordinator for the program, conduct of the needs assessment, development of State plans, and other provisions generally applicable to the program. Fifty-three of the fifty-six State Educational Agencies applied for assistance under this program. Forty-seven State Agencies submitted State Plans of Operation that were approved by the Department for funding for the first year of operation. A majority of the States will be emphasizing nutritional and foodservice management training for foodservice workers. Some of the training activities included in the plan were: workshops, college courses, certification, and development of materials.

It is anticipated that implementation of this Nutrition Education and Training Program will provide USDA with an opportunity to improve children's acceptance of food in the Child Nutrition Programs.

V. Conclusions and Recommendations

This report presents a review of current literature dealing with food consumption and the nutritional contributions of the NSLP. It also describes in detail the results of a Departmental study to determine the effects of the type of foodservice system on plate waste and nutritional characteristics of lunches served and consumed in schools in the program. Based on the results of the Food and Nutrient Consumption Study and other studies reviewed in this report, it can be concluded that in any group feeding situation, plate waste exists. The results are in general agreement as to the amounts and kinds of foods being wasted and the nutrients which are most often deficient in the lunches.

The literature review indicates that there are many factors which have an impact on the quantity of food consumed by children participating in the NSLP. Some of these factors include the acceptability of foods in the menu, quality of foods purchased, quantity of food prepared, opportunity for choices of foods, methods of merchandising and service of foods, portion sizes, environment in which lunches are served and consumed, time allowed for eating, peer pressure, attitudes of teaching and administrative staffs, and knowledge of foods and nutrition on the part of the students.

Data from studies included in the literature review and the Department's study of food and nutrient consumption in the NSLP showed the following:

A. For those studies reporting consumption data for various food categories, milk (flavored and unflavored) had the highest acceptability and consumption rate of any food category. Raw and cooked vegetables were the least accepted and least consumed foods.

B. Most Type A lunches as served to students met or exceeded the standard of one-third the RDA for protein, calcium, phosphorus, vitamin A, riboflavin, and niacin. Most lunches were lower than the standard for iron and thiamin. Food energy was consistently below the standard. Most lunches achieved a percentage of calories from fat close to the specified constraint.

C. Nutrient levels that just met the standard in lunches as served were often lower than the standard in lunches as consumed because the lunches were not entirely eaten. Consumption levels of vitamin C, riboflavin, and niacin were adequate in most studies. Vitamin A, phosphorus, calcium, and protein were lower than the standard in several of the studies. Iron, thiamin, and food energy, which were low in lunches as served, were lower in lunches as consumed.

D. Lunches prepared on site in elementary schools in the Department's study had significantly higher levels of iron and food energy than lunches preportioned and delivered. For other nutrients in lunches served in elementary schools and for all nutrients in lunches served in secondary schools, there were no significant differences in levels of nutrients associated with foodservice systems.

Lunches consumed in elementary schools with on-site food preparation furnished significantly higher levels of protein, fat, iron, thiamin, niacin, and food energy than preportioned and delivered lunches. In secondary schools, on-site lunches were significantly higher in protein and niacin and significantly lower in the percentage of calories supplied by fat than lunches preportioned and delivered. These significant differences were small.

E. Relative to the standard used in the Department's Food and Nutrient Consumption Study, thiamin and food energy were significantly higher in elementary school lunches which completely met requirements of the Type A Pattern than in lunches that did not fully satisfy the requirements. In secondary schools, only food energy was significantly higher in lunches which completely met requirements.

The preparation and service of quality food in an institutional-type setting is a complex task. Data from the literature indicate that expertise in this area could be improved and the need for additional training of school foodservice personnel becomes apparent.

A basic objective of the NSLP has been to aid in the formation of good eating habits in the lunchroom, to the end that participating children will gain a full understanding of the relationship between nutrition and health. Given these objectives, some food waste in schools is inevitable as children are served nutritious foods that may differ from the foods these children are accustomed to eating. Nutrition education is necessary to minimize this food waste.

In an effort to improve food consumption in the NSLP, the Department has initiated and/or implemented many activities which include (1) proposing revisions in meal requirements, (2) implementing "offer versus serve" provisions, (3) proposing regulations concerning the service of competitive foods, (4) encouraging on-site food preparation, (5) implementing training programs for school foodservice personnel, and (6) implementing nutrition education programs.

In conjunction with these Departmental actions, additional steps are needed at local, State, and Federal levels if current rates of food consumption are to be increased. At the local level, school and district administrators must make a commitment to the program and support it through actions such as:

1. Involving students through activities such as menu planning, enhancement of the lunchroom environment, program promotion, and related student-community support activities,

2. Involving parents, faculty, and community in activities designed to enhance the program,

3. Scheduling lunch periods that minimize length of serving lines and provide sufficient time for students to eat lunch in a relaxed manner,

4. Encouraging teachers to eat with students, to the point of arranging for teachers to have their own lunch period after the students eat (especially important in elementary grades),

5. Planning for adequate supervision of the lunchroom,

6. Developing competency requirements for school foodservice personnel and allowing opportunities for in-service training programs, and

7. Providing menu choices to students so they may select foods they are willing to eat.

State School Food Authorities should emphasize the need for the above actions when working with school administrators and encourage their implementation. It is also necessary for States to plan and execute effective training programs for school foodservice personnel. State programs to certify school foodservice personnel and the development of training workshops are good examples of needed activities. State agencies must be adequately staffed with trained foodservice personnel to be able to assist schools in achieving a high quality foodservice.

Activities such as those discussed above require a total commitment on the part of State and local program administrators. An equal commitment is necessary at the Federal level. From the inception of the NSLP in 1946, the Department has taken a sincere interest in, and provided guidance for, school foodservice operations. Food buying guides, standardized recipes, and menu planning guides are evidence of this. As the program grew, the system to support the foodservice operations grew with it, keeping the balance of program administration and foodservice operations.

The Child Nutrition Act of 1966 brought additional requirements and changes which resulted in an emphasis on program administration, but foodservice operations continued to command considerable interest. However, subsequent legislation created additional administrative demands on FNS and States, but staffing did not increase sufficiently to keep pace with these additional demands. Consequently, FNS and States responded to those program areas creating the greatest pressure -- administration (State plans, cost accounting, recordkeeping, free and reduced price meal accountability, etc.). The attention given to foodservice operations decreased accordingly.

The late Senator Humphrey stated publicly and for the record: "...we must increase our efforts to improve the quality and acceptability of food offered to children." This is the commitment required by all, a commitment which requires adequate resources and equal attention to both program administration and quality foodservice operations.

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